DOCUMENT RESUME

ED 162 154 CE 018 596

AUTHOR Gartner, Karen; And Others
TITLE Introduction to Vocations Comprehensive Middle School Program: Mathematics Activities.
INSTITUTION Rutgers, The State Univ., New Brunswick, N.J. Curriculum Lab.
SPONS AGENCY New Jersey State Dept. of Education, Trenton. Div. of Vocational Education.
PUB DATE Jul 78
NOTE 214p.; For a related document see ED 127 482
AVAILABLE FROM New Jersey Vocational-Technical Curriculum Laboratory, Building 4103, Kilmer Campus, Rutgers University, New Brunswick, New Jersey 08903 ($6.50, plus postage)

EDRS PRICE MF-$0.83 HC-$11.37 Plus Postage.
DESCRIPTORS Agribusiness; Building Trades; Business; *Career Awareness; Career Education; Communications; Environment; Health Occupations; Home Economics; Humanities; Junior High Schools; *Learning Activities; Manufacturing; Marine Biology; Marketing; *Mathematical Applications; Middle Schools; *Occupational Clusters; Occupations; Recreation; Service Occupations; Transportation

ABSTRACT

Junior high or middle school student activities in mathematics are provided for three entry level occupations in each of fifteen career clusters. The fifteen cluster titles including one of the three occupations for each cluster with an example of a student activity follow: (1) Agri-business and Natural Resources (crop dusting pilot, reading an altimeter); (2) Business and Office, (bookkeeper, totalling expenses); (3) Communications and Media (advertising salesperson, figuring cost of radio commercial); (4) Construction (electrician, calculating resistance); (5) Consumer and Homemaking (dietician, computing number of calories in a meal); (6) Environment (meteorologist, chart construction); (7) Fine Arts and Humanities (photographer, determining f-stop settings); (8) Health (pharmacist, using formulas to calculate how much solution to add to prescription); (9) Hospitality and Recreation (travel counselor, calculating trip mileage); (10) Manufacturing (automotive design engineer, determining number of oil and filter changes over 60,000 miles); (11) Marine (marine biologist, computing seven day average of pH in water samples); (12) Marketing and Distribution (carpet salesperson, computing total cost of floor covering); (13) Personal Service (tax accountant, filling out tax form); (14) Public Service (bank teller, balancing cash proof sheet); and (15) Transportation (mechanic, calculating engine displacement). Mathematical skill areas necessary in each activity and activity answers are provided in each unit. (JH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

- ED162154

State of New Jersey
Department of Education
Division of Vocational Education

INTRODUCTION TO VOCATIONS

COMPREHENSIVE MIDDLE SCHOOL PROGRAM: MATHEMATICS ACTIVITIES

Prepared By:

CAREER DEVELOPMENT TEAM:
Karen Gartner, Mathematics
Carol Moldan, Social Studies
Martin Pearson, Guidance
Robert Vinci, Mathematics
Jerry Parisi, Mathematics

Robert A. Lachenauer, Superintendent of Schools
Robert G. Gorton, Assistant Superintendent of Schools
Jean P. Masters, Administrative Assistant to the Superintendent
New Providence Board of Education

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Philip L. Edgecomb

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

Vocational-Technical
Curriculum Laboratory
Rutgers – The State University
Building 4103 – Kilmer Campus
New Brunswick, New Jersey

July 1978

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

CE 018 596

NEW JERSEY DEPARTMENT OF EDUCATION

FRED G. BURKE, COMMISSIONER

RALPH H. LATAILLE, DEPUTY COMMISSIONER

DIVISION OF VOCATIONAL EDUCATION

WILLIAM WENZEL, ASSISTANT COMMISSIONER

LOUIS V. GALLONI, DEPUTY ASSISTANT COMMISSIONER

HAROLD R. SELTZER, DEPUTY ASSISTANT COMMISSIONER

JOSEPH F. KELLY, DIRECTOR,

BUREAU OF OCCUPATIONAL AND CAREER RESEARCH DEVELOPMENT

FREDERICK L. CAPPELLO, DIRECTOR,

VOCATIONAL CURRICULUM AND MEDIA DEVELOPMENT

Project developed in cooperation with
Bureau of Special Programs
Thomas F. McNulty, Director

John W. Williams, Director,
Introduction to Vocations

TEACHING
LEARNING
MATERIALS

RUTGERS – THE STATE UNIVERSITY

PHILIP L. EDGECOMB, DIRECTOR (Acting),

NEW JERSEY VOCATIONAL-TECHNICAL

CURRICULUM LABORATORY

RUTGERS – THE STATE UNIVERSITY

BUILDING 4103 – KILMER CAMPUS

NEW BRUNSWICK, NEW JERSEY

FOREWORD

This Mathematics Activities Guide is the first in a series of four supplements to the Introduction to Vocations Comprehensive Middle School Program Handbook. Future publications in this series will provide activities for Language Arts, Science, and Social Studies.

In this guide, mathematics activities are provided for three entry level occupations in each of the fifteen career clusters. These activities can be implemented with an existing school mathematics curriculum for students in the sixth, seventh, and eighth grades. With this publication the teaching of mathematics should become more relevant to the world of work, and student awareness of career opportunities should increase.

Special recognition is given to the New Providence Career Development Team of Karen Gartner, Carol Molden, Martin Pearson, Robert Vinci, and Jerry Parisi, for their efforts in making this Career Education Project accessible to all educators.

John W. Williams, Director
Introduction to Vocations

TABLE OF CONTENTS

		Page
Foreword		I
Introduction		1
Objectives		2
Procedure		3
Skill Areas Composite		4
Mathematical Levels Composite		5
Career Clusters:		
Agri-Business and Natural Resources Cluster		
Cropdusting Pilot	(196.283)	6
Landscaper/Landscape Architect	(019.081)	10
Surveyor	(018.188)	13
Business and Office Cluster		
Bookkeeper	(213.388)	18
Computer Operations	(828.281) (020.188) (213.382) (231.258)	21
Securities Salesperson/Analyst	(020.188)	27
Communications and Media Cluster		
Advertising Salesperson	(258.358)	29
Cryptanalyst/Cryptographer	(199.288)	32
Printer	(973.381)	36
Construction Cluster		
Architect/Architectural Technician	(001.181)	39
Electrician	(825.281)	41
Roofer	(866.381)	46
Consumer and Homemaking Cluster		
Budget Consultant	(096.268)	49
Dietician	(007.168)	52
Market Researcher	(050.088)	56

		Page
Environment Cluster		
Environmental Scientists	(003.281)	60
Meteorologist/Weather Consultant	(025.088)	63
Sound Crew Person/Accoustical Technician	(003.081)	67
Fine Arts and Humanities Cluster		
Film Processor	(976.381)	71
Model Maker	(693.380)	74
Photographer	(143.062)	82
Health Cluster		
Hospital Administrator	(187.118)	86
Pharmacist	(074.181)	89
Psychologist/School and Experimental	(045.088)	93
Hospitality and Recreation Cluster		
Statistician (Sports)	(020.188)	98
Tennis Court Manager	(341.368)	103
Travel Counselor	(353.368)	108
Manufacturing Cluster		
Automotive Design Engineer	(007.181)	112
Physicist	(023.081)	116
Sales Manager	(163.118)	122
Marine Science Cluster		
Chemical Oceanographer	(024.081)	125
Marine Biologist/Field Researcher	(041.081)	129
Physical Oceanographer	(024.081)	140
Marketing and Distribution Cluster		
Carpet Salesperson	(290.478)	145
Shipping Clerk	(222.138)	148
Small Business Owner	(-------)	150

Page

Personal Service Cluster

Chef/Cook . . . . . (313.381) 152

Optician . . . . . (713.381) 155

Tax Accountant . . . . . (160.188) 159

Public Service Cluster

Bank Teller . . . . . (212.368) 165

Meter Reader . . . . . (239.588) 168

Tax Assessor . . . . . (188.188) 173

Transportation Cluster

Flight Engineer . . . . . (621.281) 177

Mechanic. . . . . (620.281) 180

Toll Collector . . . . . (211.468) 183

INTRODUCTION TO VOCATIONS

COMPREHENSIVE MIDDLE SCHOOL PROGRAM: MATHEMATICS ACTIVITIES

This activities program for mathematics is a further refinement of the existing publication, Introduction to Vocations Comprehensive Middle School Program. As the title indicates, this publication provides a general overall direction for a middle school career development program. This project of mathematics activities is intended for use in grades six, seven and eight with specific emphasis upon integration of the fifteen career clusters into the district's existing curriculum. It is recommended that these mathematics activities be used in conjunction with the comprehensive program.

Each of the fifteen career clusters will be considered in separate units. The activity will both describe a related occupation and provide mathematics lessons which will emphasize how mathematics skills or concepts are involved in the occupation. The mathematics operations will involve theory and practice presently existing in the middle school curriculum in the New Providence School District. Because of the flexibility for the teacher in this program, no course of study alteration is necessary.

The career content of the program will provide the middle school students with realistic information about the world of work.

OBJECTIVES

The following objectives provide direction for the program:

1. The student will become aware of the relevancy of mathematics in the world of work.

2. The student will demonstrate an understanding of essential mathematical concepts and will develop skill in computations involved in mathematical applications.

3. The student will be able to realize the differences and intensities of mathematical backgrounds necessary in specific careers.

4. The student will be able to make a self-appraisal of his/her capabilities and interests.

5. The student will be able to become aware of a wide variety of occupations and appreciate the individuals involved in these jobs.

6. The student will be able to begin a foundation for career planning suitable to his/her own needs.

7. The student will demonstrate an understanding of non-traditional career options.

PROCEDURE

This program is divided alphabetically into the fifteen career clusters. Each career cluster is a unit of career-related mathematics activities for the students. The selected career is described and in each case the student activities follow. Each activity incorporates various aspects of the middle school math curriculum. This approach enables the project to be applicable to the existing curriculum. The skill areas which are necessary in each activity are listed along with the activity answers on the last page in each cluster.

Every attempt has been made by the career development team to present career information in a realistic, factual and relevant fashion. The intent is to provide students with mathematics activities which will increase their awareness of the world of work.

Much of the material included is in workbook form. Therefore, it is suggested that teachers freely duplicate these pages, thus preserving the original.

SKILL AREAS / COMPOSITE	Cropdusting Pilot	Landscaper	Surveyor	Bookkeeper	Computer Operations	Security Salesperson	Advertising Salesperson	Cryptographer	Printer	Architect	Electrician	Roofer	Budget Consultant	Dietician	Market Research Analyst	Environmental Scientist	Meteorologist	Sound Crew Person	Film Processor	Model Maker	Photographer	Hospital Administrator	Pharmacist	Psychologist	Statistician	Tennis Court Manager	Travel Counselor	Automotive Design Engineer	Physicist	Sales Manager	Chemical Oceanographer	Marine Biologist	Physical Oceanographer	Carpet Salesperson	Shipping Clerk	Small Business Owner	Chef/Cook	Optician	Tax Accountant	Bank Teller	Meter Reader	Tax Assessor	Flight Engineer	Mechanic	Toll Collector
Place Value	x																																												
Whole Numbers + - x ÷	x	x			x		x		x		x	x	x	x		x		x	x		x	x	x	x	x	x	x	x		x		x				x								
Fractions + - x ÷			x																				x									x										x			
Decimals + - x ÷	x	x		x		x	x					x		x					x				x	x			x	x	x		x					x	x							
Integers + - x ÷					x																		x	x				x	x		x	x		x			x		x		x	x	x	x
Powers of 10		x																x	x							x																			
Area		x										x							x																										
Scale Drawing			x							x										x														x							x				
Angle Measurement			x																	x																									
Exponents					x																																								
Gauge Reading	x																																												
Graphs, Charts						x											x	x											x	x															
Ratio and Proportion									x	x									x	x									x	x			x											
Measurement									x																	x																		x	
Formula Application																					x													x										
Square Roots																								x																			x	x	
Averages																		x														x												
Rounding																														x			x											
Percent of a Number						x						x	x			x		x	x			x	x						x	x			x	x	x									
Finding Percents								x					x		x				x			x			x				x					x	x	x								
Given percent, find number																																			x	x									
Frequency Distribution								x																											x	x									

MATHEMATICAL LEVELS COMPOSITE	Cropdusting Pilot	Landscaper	Surveyor	Bookkeeper	Computer Operations	Security Salesperson	Advertising Salesperson	Cryptographer	Printer	Architect	Electrician	Roofer	Budget Consultant	Dietician	Market Research Analyst	Environmental Scientist	Meteorologist	Sound Crew Person	Film Processor	Model Maker	Photographer	Hospital Administrator	Pharmacist	Psychologist	Statistician	Tennis Court Manager	Travel Counselor	Automotive Design Engineer	Physicist	Sales Manager	Chemical Oceanographer	Marine Biologist	Physical Oceanographer	Carpet Salesperson	Shipping Clerk	Small Business Owner	Chef/Cook	Optician	Tax Accountant	Bank Teller	Meter Reader	Tax Assessor	Flight Engineer	Mechanic	Toll Collector
Low	x			x		x				x			x																x						x	x				x				
Low to Average							x																				x												x						x
Average		x							x					x	x	x	x			x		x			x		x			x				x										
Average to High					x						x	x							x				x						x			x												
High			x					x										x			x			x							x										x				

AGRI-BUSINESS

NATURAL RESOURCES

CLUSTER

Crop Dusting Pilot
Landscaper/Landscape Architect
Surveyor

Agri-Business Natural Resources Cluster

CROP DUSTING PILOT

The success of the agricultural business depends on the dedicated assistance of many qualified and skilled personnel. Timing is an all important factor for the agri-business field. A maximum crop yield can be realized if the ground tilling, the planting, the irrigation and the fertilization is completed as close to the scheduled growing season as possible. Through modern technology, the agri-business industry has been able to overcome such problems in nature as limited rainfall and soil depletion. Therefore, barring any unforeseen natural disasters, a maximum crop harvest can be expected.

An important part of the growing process is fertilization and pest control. The agricultural industry depends on the valuable services of the crop duster. A skilled pilot carefully navigates his/her plane over the crop and dispenses the fertilizer or insecticide. This artful operation demands the expertise of experienced pilots. They must manuever their airplanes at very low altitudes, taking care to dispense the correct amount of chemicals and to calculate their distance from the ground.

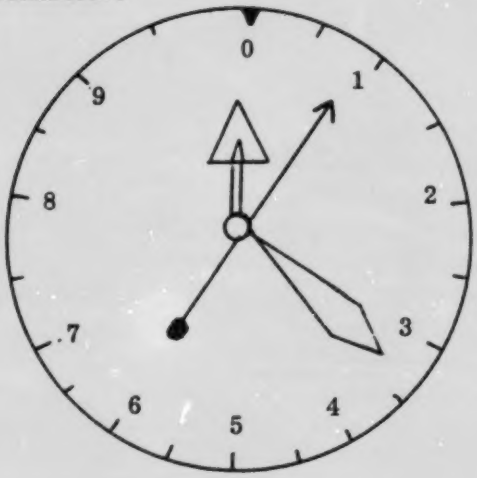
The crop duster is an important occupation related to the agri-business industry. In the following activity you will gain experience in reading a pilot's altitude instrument and calculating actual flight altitudes.

Activity

One of the most important instruments used by the crop dusting pilot is the altimeter. This instrument tells the pilot how high above sea level he/she is flying. It is especially vital for the crop duster to be aware of this reading as he/she is manuevering the aircraft over a somewhat limited area of designated field.

The altimeter is based upon the fact that atmospheric pressure decreases with height above sea level. Atmospheric pressure is 14.7 pounds per square inch at sea level. As the altitude of the plane increases, atmospheric pressure decreases.

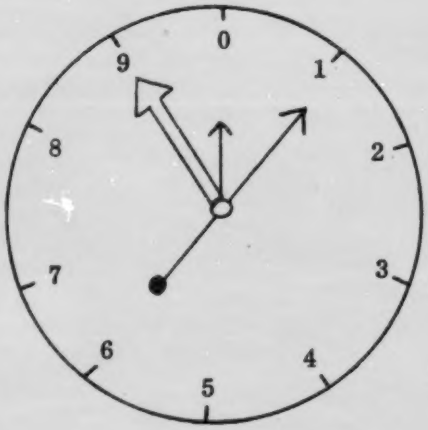
Altimeter:

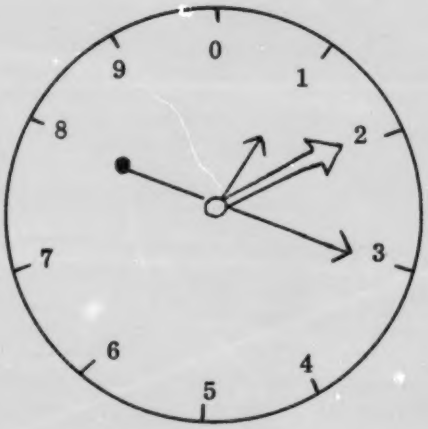


Three pointers are geared together. The longest pointer registers hundreds of feet, the next pointer registers thousands of feet, the shortest measures tens of thousands of feet.

The reading of this altimeter is 3,850.

1. As a crop dusting pilot you must be sure to maintain a safe altitude. Read the following altimeters.





A_____ B_____ C_____

2. Using the above altimeters, in which case is the atmospheric pressure the lowest? Select Altimeter reading A, B, or C. _____.

Atmospheric Pressure Readings

Atmospheric pressure is measured in millibars. For every 30 ft. increase in altitude the atmospheric pressure will drop by one millibar.

NOTE: The atmospheric pressure at sea level is 1013.2 millibars (14.7 lbs. per sq. inch)

Example: At a 3,000 ft. altimeter reading the atmospheric pressure will be 100 millibars less than sea level pressure.

1013.2 millibars sea level	913.2 millibars is the
-100.0 millibars	atmospheric pressure
913.2 millibars	at 3,000 ft. altitude

3. Complete the following atmospheric pressure readings at the altitudes given:

   A. Altitude of 9,300 ft: _____

   B. Altitude of 2,100 ft: _____

   C. Altitude of 4,500 ft: _____

   D. Altitude of 12,000 ft: _____

4. A crop dusting pilot dispensing insecticide over a peach orchard in South Jersey must maintain a safe altitude of 35 ft. Draw an altimeter showing this altitude reading.

ANSWERS:

1. Altimeter readings A. 2,400 ft.

   B. 9,100 ft.

   C. 12,300 ft.

2. Lowest pressure is C.

3. Pressure Readings A. 703.2 millibars

   B. 943.2 millibars

   C. 863.2 millibars

   D. 613.2 millibars

4. Two smallest pointers should be shown registering 0.
   The longest pointer less than half between 0 and 1.

SKILL AREAS:

Whole Numbers: Division

Decimals: Subtraction

Gauge Reading

Agri-Business Natural Resources Cluster

LANDSCAPER/LANDSCAPE ARCHITECT

Landscape architects, civil engineers and city planners are responsible for making the land beautiful and functional while protecting our valuable natural resources. Teams of these individuals determine: the grading and excavation of the earth, the arrangement of shrubs, gardens, trees, and building size.

The landscape architect measures and blueprints the commercial or private site and suggests designs to the client. Therefore, this career area necessitates a background in engineering, mathematics, surveying and cost estimation. The landscape architect should enjoy the outdoors and nature as well as have the technical skills needed to successfully complete the designated site.

The following activity will involve you in some of the problems which would concern the landscaper.

Activity

As part of the new garden apartment complex, there will be a triangular court in the form of a right triangle. The dimensions and important information are supplied in Figure 1. As a landscaper, you will enter into a contract with the apartment owner regarding the cost of both your materials and labor. The following problems are mainly concerned with material costs and they will give you some idea about the nature of the problems facing a landscaper.

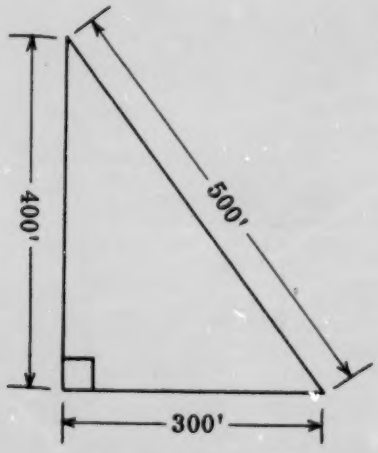


Figure 1

1. The owner would like all of the triangular region covered with sod. If sod costs 12¢ per square foot, installed, what would be the cost for this part of the project? _____

2. The owner wishes to use only junipers and azaleas to outline the court. You decide to have them equally spaced around the border, 5 ft. apart, alternating juniper and azalea. If azaleas cost $12.50 each and junipers cost $17, what would be the total cost of the shrubs to be used around the border of the court? _____

3. Your contract with the owner requires you to apply fertilizer to the new sod 6 weeks after installation. Fertilizer costs $27.50 for a bag which will cover 15,000 sq. ft.

   a) How many bags will be needed? _____

   b) How much will it cost to fertilize the sod? _____

4. Using the results of problems 1, 2 and 3, compute the total cost of this contract. _____

5. a) Decide on the dimensions of a rectangular court which would use the same number of shrubs with the same spacing as in the triangular court in Figure 1. Make a sketch of this court and label the dimensions.

   b) Compute the sod and fertilizer costs for this court using the costs in the previous problem.

   c) Which court would cost less to landscape, the triangle or your rectangle? Explain.

   d) If the answer to part c) is triangle, then search for a rectangular court which does cost less. Make a sketch of this court and label the dimensions. Show how much this rectangular court will save on fertilizer and sod as opposed to the original triangular court.

ANSWERS:

1. Area of triangle is 60,000 square feet.
   Cost is $7,200.

2. Need 30 + 40 + 50 = 120 junipers at cost of $2,040
   Need 30 + 40 + 50 = 120 azaleas at cost of $1,500
   Total cost = $3,540

3. a) 4 bags
   b) $110.

4. 10,850

5. a) will vary (any rectangle with 1200' perimeter)

   b) will vary

   c) will vary

   d) will vary (example 100' by 500')

SKILL AREAS

Whole Numbers: Division

Division by powers of 10

Decimals: Addition, subtraction, multiplication

Area: Rectangle, right triangle

Agri-Business and Natural Resources Cluster

SURVEYOR

Students should consider a career in surveying if they are interested in outdoor work with considerable mathematics involvement.

The professional surveyor must have a state license and be a graduate of a four year college program in engineering. People in this occupation do have available various areas of specialization. Some of these include:

1) Property boundary surveyors establish or verify land titles, deeds, and leases.

2) Highway surveying involves planning new roads.

3) A hydrographic surveyor measures depth and location of bodies of water.

For the person interested in this job area, there are other avenues besides a college course of study. Technical-vocational training combined with on the job experience can lead to recognition as a skilled assistant to the professional surveyor. There are also opportunities for semi-skilled employment. These individuals work with such equipment as metal tapes and chain poles.

The outlook is a good one for persons looking for employment in surveying. New buildings and highways are being constructed and the surveyor and his/her crew play a vital role in these projects.

Activity

Perhaps you have seen a surveying team working along the roads and properties of your town. The surveyor and his/her helpers work as a team. The main tool of a surveyor is called a transit or theodolite (consult your library for a picture). It consists of a telescope mounted on a series of protractors. The telescope also has crosshairs to aid in lining up a target. Essentially, a transit measures two types of angles: angles on a horizontal plane, or angles on a vertical plane. When reading angles on a vertical plane, the term "angle of elevation" is used to mean the angle formed from the horizontal line of sight to the object which is above the horizontal (fig. 1).

The surveyor's helper used a pole calibrated with inch and foot measurements. Think of it as a 15' ruler! It has a sliding target to enable the crosshairs in the telescopic sight on the transit to line up exactly (fig. 2).

If a surveyor wishes to find the difference in elevation between the front property line and the back, he/she will take two readings on the pole and a subtraction will yield the answer. Specifically, he/she will set up the transit somewhere on the property and level the equipment. The transit must be level in order to ensure that the telescope points along a horizontal plane. Then, the helper goes to the front of the property and when the pole is vertical he/she moves the target up or down until the surveyor indicates with a wave of his/her hand that the target lines up with the telescopic sight. The helper will now read the height of the target on the pole and record this information. The helper then moves to the back property line and the team follows the same procedure. The subtraction of these two readings is the difference in elevation (fig. 3).

1. A groundskeeper for a baseball team wants to determine how much the pitcher's mound is elevated above home plate. A surveyor may be used as in the explanation described above!

   a) Suppose the target reading at home plate is 5' $3\frac{1}{2}$" and the reading at the pitcher's mound is 3' $1\frac{1}{4}$". What is the difference in elevation?

   b) Suppose the readings are 6' $2\frac{1}{4}$" and 3' $4\frac{1}{2}$"?

2. A surveyor needs to find the distance from the front property line to the back. However, a tape measure cannot be used because of a stream which runs across the property. Use the labeling of fig. 4 to follow the procedure for obtaining this information.

   From point A use a tape measure to measure off some convenient distance, say 100', to point B. The surveyor sets up the transit at point A and the helper is at point C. The measure of angle 1 is recorded. The transit is then moved to point B and the measure of angle 2 is recorded. Using just measures of angle 1 and angle 2 and the distance from A to B, the distance from A to C can be calculated. Actually, this calculation is performed by using Trigonometry (an advanced mathematics subject), but we can find the information from a scale drawing. Suppose that angle 1 = 80°, angle 2 = 60°, and AB = 100'. Use this information in a scale drawing to find the distance AC.

3. (Optional). To find the height of a mountain, the surveyor needs only four pieces of information (three angles and one distance). The computation using this information will involve two separate trigonometric calculations or in your case two separate scale drawings. Follow diagrams fig. 5 and fig. 6 for the technique. Fig. 5 is exactly like Activity 2. The surveyor needs angle 1, angle 2 and the distance from D to E. You will need to use a scale drawing to find the distance from D to F. Next, you must use the reasoning of Fig. 6 which involves a right triangle which is theoretically buried in the mountain. Here, the surveyor needs the angle of elevation, angle 3. Use this information to make a scale drawing of triangle DGF and find the distance from F to G. This is the height of the mountain!

   Use the following information to compute the height of this mountain: angle 1 = 85°, DE = 100', angle 2 = 80°, angle 3 = 75°.

DIAGRAMS

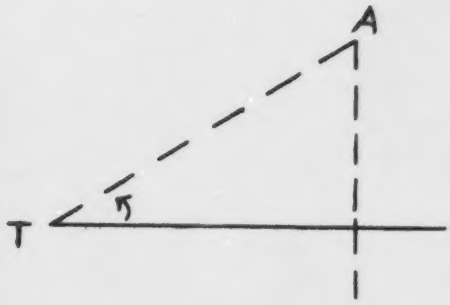


Figure 1

Figure 2

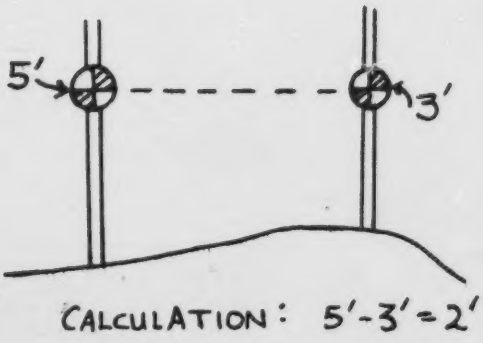


Figure 3

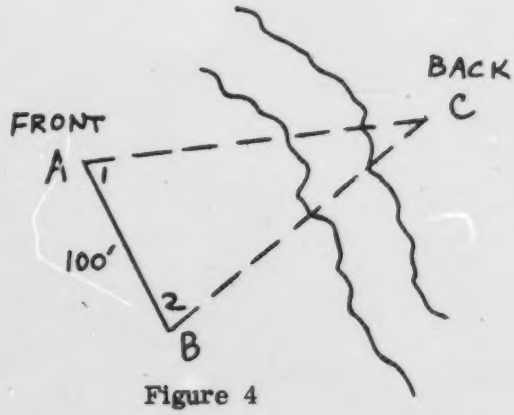


Figure 4

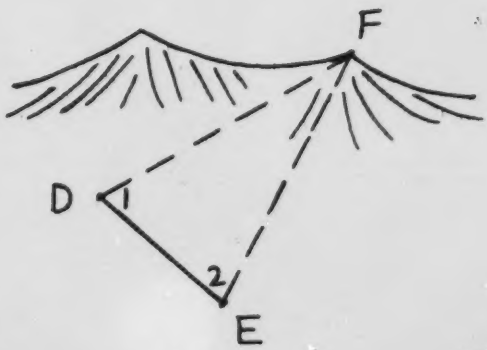


Figure 5

Figure 6

ANSWERS:

1. (a) $26\frac{1}{4}'' = 2' 2\frac{1}{4}''$

   (b) 2' 9-3/4" = 33-3/4"

2. Approx. 135'

3. Approx. 368'

SKILL AREAS

Scale Drawing

Fractions: Subtraction

Angle Measurement

BUSINESS AND OFFICE

CLUSTER

Bookkeeper
Computer Operations
Security Salesperson/Analyst

Business and Office Cluster

BOOKKEEPER

Keeping up-to-date records of business transactions and financial accounts requires the specialized skills of a bookkeeper. This work involves calculating, recording and balancing many statements and reports. Although much of the bookkeeper's computation is performed by machines, these persons must keep track of a business's ledgers, journals, papers and files. The patience for detail and a business mathematics education are important prerequisites for this career area.

In large corporations, a department of bookkeepers with assigned tasks handles the financial accounts. However, with small firms, one bookkeeper may be responsible for all records and transactions. Therefore, an individual possessing an overall business background would be a valuable asset to this company.

Employment opportunities in this career area remain numerous despite the increasing use of data processing and bookkeeping machines. However, as a result of these changes, careful career planning is most essential for individuals with interests in this field.

Activity

As a bookkeeper of a business, you will have to keep accurate records of all business and financial transactions. Monthly expenses must be recorded as well as any income adjustments.

Complete the following bookkeeping activity for a small firm:

Expenses		Receipts	
Bell Telephone	... $ 48.75	Payments from Williams Company, Inc.	... $1,538.50
Public Service Electric and Gas Co.	... $ 97.60	Payment from Sal Contractors	... $ 610.00
Lifetime Insurance Co. (Building and Employee Insurance)	... $ 127.25	Payment from Allstate Insurance Co.	... $ 885.75
Rent-all Association (Owners of the building which your employer rents)	...$ 575.00	Payment from Shell Oil	... $ 415.50
Tru-paper Products	...$ 276.80		
Parcel Postal Service	...$ 52.75		
Jersey Daily News (advertising)	...$ 42.00		
Salaries	...$ 1,525.00		

1. What are the total expenses?

2. What are the total receipts?

3. Deduct $.10 per check for the first seven expenses.

   What is the net profit for this month?

4. What is the profit per year, assuming the receipts and expenses do not vary?

ANSWERS:

1. Total expenses - $2,745.15

2. Total receipts - $3,449.75

3. Net profit - $703.90

4. Yearly profit - $8,446.80

SKILL AREAS:

Decimals: Addition, subtraction, multiplication

Business and Office Cluster

COMPUTER OPERATIONS

Computer operations is a rapidly expanding field of employment. With new uses for computers constantly being developed, manufacturing and business firms need highly skilled persons to program, operate and maintain this technical data processing equipment. Individuals in computer operations understand actual computer functions including: the primary input of data, the processing of information for immediate or future use and the output or print out of the data. Employees who insure this functioning include keypunch operators, computer programmers, computer console operators and computer service technicians.

The keypunch operator, usually a skilled typist, actually punches the coded data onto the program cards. The cards are then fed into the computer.

The computer programmer begins the operations by making a flow chart for the computer process. The next step is writing the instructions for the computer to follow. The programmer is constantly concerned with formulas and numbers.

The computer console operator receives the coded information or input from the programmer. At this point, the console operator loads the computer with this coded information which could be in the form of cards or tapes. A genuine understanding of a computer technology is important for this occupation.

As with most mechanical systems, the repair and maintenance of the equipment is a full-time responsibility. Computer service technicians perform this valuable service as well as the installation of new systems.

As you can see, the computer operations field is an occupation area of limitless possibilities. To give you some understanding of the work of computer programmers, you will undertake the following activity involving the construction of a flow chart.

Activity

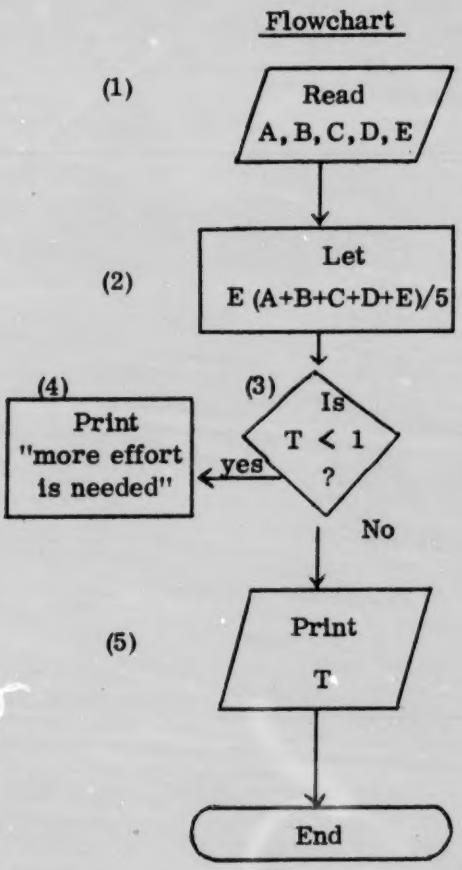
A computer language is a set of codes which is understandable to the computer.

There are many computer languages but to learn the details of all would be not only impossible but unnecessary. The computer programmer goes to school to learn general programming techniques. He/she will learn the specifics of a particular language when he/she obtains a job in the field. Usually the company that hires the programmer will require extensive training in the language for that system. This training will be done while the programmer is employed by the company and at the company's expense.

The programmer must, using the language of the system, write a "Program" which is transferred to computer cards by the keypunch operator. A program is a planned sequence of instructions that tells a computer system what steps to perform in order to produce a desired output.

The planning of the sequence of instructions is an important part of a programmer's job. He/she often plans the sequence using the technique known as "Flowcharting".

Study the following sample problem for finding the average amount of time spent doing homework for a 5-day period. A flowchart would be done first because it is a step-by-step outline of the procedures to be followed by the computer. Here is the flowchart:



A trace is a simulated "run" of a program. You can develop trace from a flowchart. The boxes in the above flowchart are labeled for reference in these examples, but normally would not be numbered. Study the following completed trace:

INPUT: 2 for A, 1 for B, 3 for C, 4 for D, 2 for E.

Box	A	B	C	D	E	T	Yes or No	Output
1	2	1	3	4	2			
2						2.4		
3							No	
4								?
5								2.4

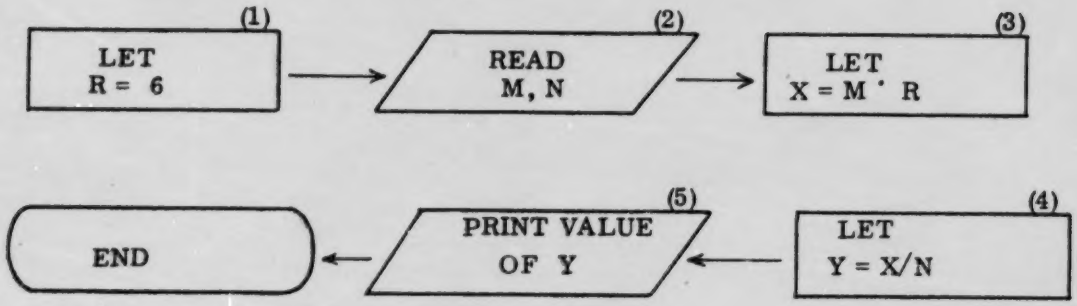
(1) The following trace refers to the same problem. You supply the missing numbers.

INPUT: 2 for A, 0 for B, 0 for C, 1 for D, 0 for E.

Box	A	B	C	D	E	T	Yes or No	Output
1	?	?	?	?	?			
2						?		
3							?	
4								?
5								?

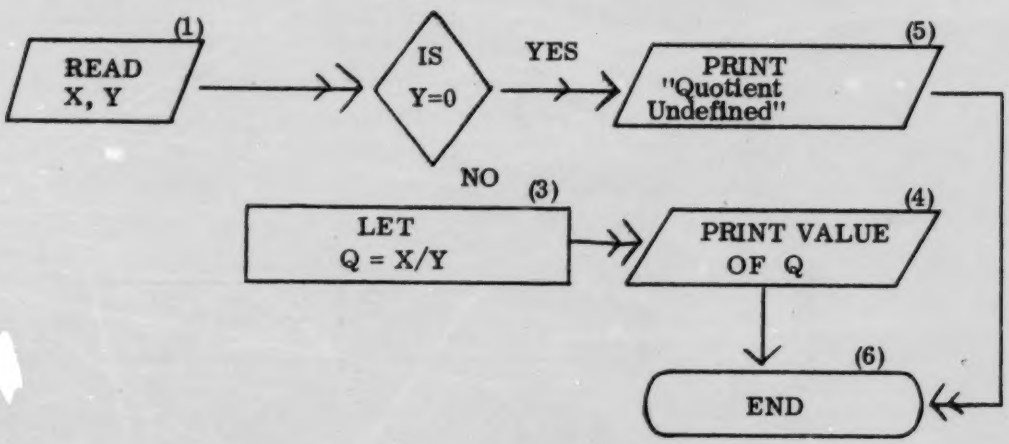
(2) Complete the trace for the following flowchart:

INPUT 10 form and -4 for N



Flowchart Box Number	Value of Variables					OUTPUT
	R	M	N	X	Y	
1	6					
2		10	?			
3				?		
4					-15	
5						?

(3) Complete the traces for this flowchart. In the first trace, let X=7 and Y = 2. In the second trace: Input 22.5 for X and 0 for Y.



Flowchart Box Number	Value of Variables X	Y	Q	Decision	Yes or No	Output
1	?	?				
2				2=0 ?	?	
3			?			
4						?

Flowchart Box Number	Value of Variables X	Y	Q	Decision	Yes or No	Output
1	?	?				
2				?	Yes	
5						?

(4) Make your own flowchart for the following:

Compute the reciprocal of a number.

(5) Library Research

(a) List and briefly explain 3 kinds of input devices used with computers

(b) Most computer languages have names which are formed from words or parts of words which are descriptive of the language.

For example: The letters A P L are the first letters in the words:
"A Programming Language"

Find the words used to create the following language names. (Do 2 of 4).

1. FORTRAN
2. BASIC
3. COBOL
4. ALGOL

ANSWERS:

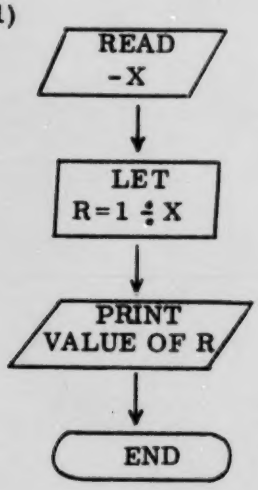
1. 2, 0, 0, 1, 0, .6, Yes, More Effort Is Needed

2. -4, 60, -15

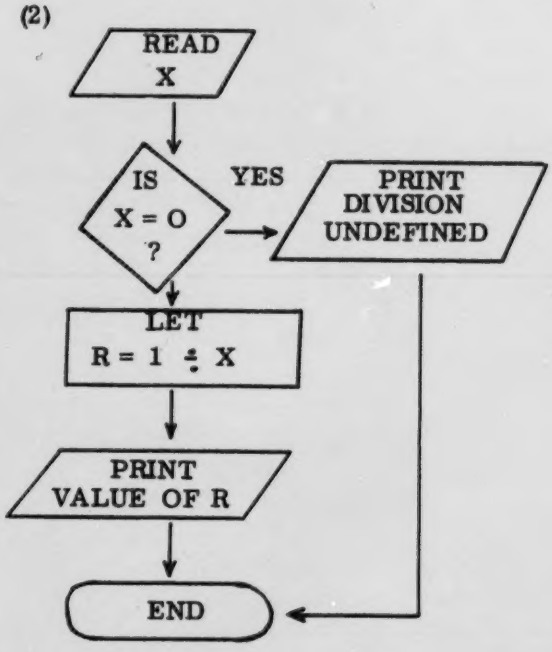
3. (a) 7, 2, NO, 3.5, 3.5
   (b) 22.5, 0, Y=0 ?, Quotient Undefined

4. These are typical responses:

(1)



(2)



Note: If the student does not consider X=0, as in Flowchart #1 above, teacher should suggest this case be included.

5. (a) Punched Cards, Punched Tape, Magnetic Tape, Teletype
   (b) Fortran - Formula Translation (Reference: Compton's Encyclopedia)
   Basic - Beginners All-Purpose Symbolic Instruction Code (Ref.: Compton's)
   Cobol - Common Business Oriented Language (Ref.: Compton's)
   Algol - Algorithmic Language (Ref.: Colliers')

SKILL AREAS:

Whole Numbers: Multiplication, division
Division by Zero
Exponential Notation
Integers: Multiplication, division
Use of Variables

Business and Office Cluster

SECURITIES SALESPERSON/SECURITIES ANALYST

Securities investment is a large business area in the United States. As the number of investors increases, the counseling services of securities salespersons will be in greater demand. When a client wishes to buy or sell securities, the securities salesperson handles the negotiations through the Stock Exchange. Therefore, the securities salesperson must maintain current knowledge of general economic and market conditions so as to best serve the investment interests of his/her customer. It is important for an individual desiring a future in this career area to develop logical reasoning ability.

A related occupation in the stock and bond business is the securities analyst. This individual, through statistical studies, determines profits, trends and market stability. The results of his/her studies are evaluated and given to the securities salesperson for the stocks or bonds customer. The analyst may act as the salesperson or investment counselor. Financial analysts can be self-employed or work for insurance agencies, banks or investment institutions.

Both of these career areas require a person who enjoys working with current economic concepts. To be successful in these occupations, one must be able to read and digest volumes of stock reports and investment computations. The securities business provides both a demanding and rewarding area of employment.

Activity

1. As a securities analyst, you are interested in the trends of specific stocks. A close friend wants to invest $2,000 in the stock market. Check the newspaper financial section and choose one to three different stocks and buy as many shares as possible without going over the limit of $2,000. List these stocks, their cost per share and total cost of all shares in a chart. Record the "ups and downs" of each stock for 7 days using the closing prices for each day. Then make a graph of each stock to show the trends. At the end of the week, sell the stocks at the highest price during that day. Have you shown a profit or loss? By how much?

2. A client has decided to buy 125 shares of Xerox - each $100\frac{1}{4}$. This means one share costs $100.25. With the brokerage commission of 3%, compute the total costs to the customer.

3. Two years later the client returns to sell his/her stock in favor of a new computer company. Xerox shares are selling at $100\frac{1}{2}$. What profit, if any, did the client make? Be sure to remember that a brokerage fee must be paid.

ANSWERS:

1. The students' answers will vary:

   chart of costs of stocks
   graph for each stock to show its trend
   net gain or loss per stock

2. $12,907.19

3. Loss - $32.19

SKILL AREAS:

Construction of graphs and chart
Decimals: Addition, multiplication, subtraction
Changing fractions to decimals
Finding percent of a given number

COMMUNICATIONS

AND

MEDIA

CLUSTER

Advertising Salesperson
Cryptanalyst/Cryptographer
Printer

Communication and Media Cluster

ADVERTISING SALESPERSON

Television, radio and newspapers provide information and entertainment for the public, but the media's main source of income is through advertising of goods and services. When a prospective advertiser wishes to purchase time on television, radio or space in a newspaper, an advertising salesperson will take this order and perhaps lend advice as to overall costs, special rates, etc.

Individuals in this career area need a good background in basic math, a pleasant personality, voice and appearance. Most people in this occupation are high school graduates and many who are seeking greater advancement have college degrees in Business Administration.

The employment outlook in this career area is good since advertising in the mass media is a vital part of the business world. Opportunities exist, but competition is keen, and the successful person is the one with the best qualities of perseverance and drive!

In the following series of problems, the roles of three advertising people are detailed.

Activity:

1. As an advertiser for Crunchies Potato Chips, you decide to contact a local radio station for advertising your product. This radio station charges $9 per 60-second spot, announced 21 times each week. The 30-second spots, also announced 21 times a week, cost $7 per spot. You have decided to advertise your product for one year using the half minute spots. What would be the total cost of this advertising for the Crunchies Corporation?

2. The Crunchies Corporation has increased its sales to such an extent that the management decided to advertise with soda commericals on television. A local television station in New Jersey offers the following prices for five commercial spots per week:

   30-second spots - $105 each
   60-second spots - $180 each

   As the advertising director, you now decide to budget $18,900 for television commercials. How many weeks will your commercials run if they are full minute spots? With the same monetary amount, how many weeks will half minute spots run?

3. To complete your advertising program, you have requested space in a local newspaper. A small ad, in black ink only, is $1.39 per line during the week, and $1.87 per line on Sundays. What will be your advertising costs for 12 lines on Sunday describing the crispy texture, superb quality and natural ingredients of Crunchies Potato Chips for 40 Sundays?

4. What is your total advertising budget for newspaper, television and radio for this year?

ANSWERS:

1. $7,644

2. 21 weeks, 36 weeks

3. $897.60

4. $27,441.60

SKILL AREAS:

Whole Numbers: multiplication, division

Decimals: addition, multiplication

Communication and Media Cluster

CRYPTANALYST/CRYPTOGRAPHER

Successfully decoding material demands careful thinking, analyzing and often some logical guessing. Cryptanalysis is this fascinating field which requires persons with inquisitive minds. Computer technologists have shown major interest in the work of cryptanalysts. Among the areas of employment for cryptanalysts are the military, large corporations, historical research, law enforcement and intelligence and computer research. Decoding, encoding or deciphering military messages, diplomatic correspondence, historical documents, secret intelligence information, criminal messages require the skills of a cryptanalyst. Large corporations and computer research companies are interested in cryptanalysis as a means of enciphering information for a computer system. Historic cryptographic messages are challenging and often the solution will add to our knowledge of the past. The cryptogram that appears in daily newspapers also illustrates this career area.

To a large degree, this specialized career area depends on using higher mathematics and statistics. Knowing the frequency distribution of letters in a cipher or code for example, is instrumental for the eventual solution. Students should study related mathematics courses in algebra and statistics. Computer companies, large corporations and the government would require candidates to have college degrees in many cases. A small number of colleges offer courses in this specialized area, but interest seems to be rising rapidly.

For ambitious individuals with a desire for the unusual and mysterious, cryptanalysis offers a variety of career opportunities.

Activity

1. Pretend the CIA has asked you, a famous cryptographer, to decipher an important military code. The code is not separated into words, so there are no clues about lengths of words. There are 128 letters in all. Try to solve this cryptogram by yourself first.

S V P Q C N S P A B S G S P B T
X G T L P A S V P Z G N C T W A
P W M S V P Y G H G C P B P C G
M F L C W K R P A D P W M S V P
T W A P H R G F P A G C N Z H W
X S G C S X W R P N C S V P G Z
P X N T G C M N T S W X F G S S
V P Z G S S R P W M Z N A K G F

If you need help in deciphering the code, here are a few hints:

a) Copy the code on your paper, leaving 2 blank lines between each line of letters. Then check to make sure that every letter has been copied correctly.

b) To get some clues about what letter each letter represents, write the alphabet in a column and tally the number of A's, B's, C's, etc. This is called a frequency distribution.

c) From the frequency distribution for the English language, (see below), the most frequently used letter is probably "E". Write this underneath each place this letter appears in the cipher:

Frequency Distribution

Letter	Percent Frequency
E	13
T	9
A, O	8
N	7
I, R	6.5
S, H	6
D	4
L	3.5
C, U, M	3
F, P, Y	2
W, G, B	1.5
V	1
K, X, J	0.5
Q, Z	0.2

(d) As seen from the chart, the second most frequently used letter in the English alphabet is probably "T". Write a "T" underneath each place in the cipher.

(e) A very common word in the English language is "The". If this word appears several times in the cipher, it will probably be easy to guess the letter "H".

(f) Another hint in solving a cipher is some knowledge of certain words that are likely to appear. For example, since this is a military code, it might mention the United States. If you can find those words, you will know several more letters.

(g) The most frequent letters in written English are: E, T, O, and H. By now you should have decoded all of the letters except O. Look at the letters with the highest frequencies in your frequency distribution. Guess which letter stands for O.

(h) Solve the rest of the code; You are on your own!

2. Sometimes a cryptographer is asked to encode a message, rather than to decode one. Write a secret message. Then encode it with any letter or picture code you choose. Hand the coded message to a friend to see if it can be deciphered. If needed, give 2 hints.

3. Look again at the frequency distribution for the letters of the English language. Why do you think the Morse Code uses a dot for the letter "E" and a dash for the letter "T"? Write a short report on how the Morse Code was developed.

4. Choose a page at random from an encyclopedia. Using at least 1/4 of the page, count the number of letters, then make a frequency distribution showing the number of times each letter of the alphabet occurs. Compute the percent frequency and compare this with the table. How do they compare?

5. A cryptanalyst uses many terms that might be new to you. Each term has a very specific meaning. Define each term below and use in an appropriate sentence:

Cryptogram
Code
Cipher
Diagram
Null
Ogams
Cryptographer
Decipher
Decode

Supplemental Readings:

The Codebreakers by David Kahn, Macmillan Publ., 1967

Famous Stories of Code and Cipher, edited by Raymond T. Bond, Collier Books, 1965

Gadsby, A Story of Over 50,000 Words Without Using the Letter E by Ernest Wright, 1939

ANSWERS:

1. The deciphered message is:

THE UNITED STATES CRACKED THE MAIN CODE OF THE JAPANESE NAVY. KNOWLEDGE OF THE CODE PLAYED AN IMPORTANT ROLE IN THE AMERICAN VICTORY AT THE BATTLE OF MIDWAY.

2. Answers will vary.

3. Letters E and T occur most frequently in our alphabet.
Dots and dashes are easiest to make.

4. Answers will vary.

5. Definitions of terms:

Cryptogram	-	a writing in cipher or secret arrangement of letters or words.
Code	-	method of writing in which each word is written as a secret word, symbol, etc.
Cipher	-	system of writing in which each letter has a secret symbol.
Diagrams	-	certain letters which often occur together
Ogams	-	cipher letters invented by Celts
Nulls	-	letters having no meaning in the code; used as a trick
Cryptographer	-	person who uses codes or ciphers
Decipher	-	to translate secret letters into intelligible terms
Decode	-	to convert secret words into intelligible ones

SKILL AREAS:

Percent: finding percent

Frequency Distribution Table

Communication and Media Cluster

PRINTER

The printing industry offers many different specialized careers. Skilled craftworkers are found in such occupations as layout artists, photo-engravers, letter-press operators. Persons who apply for employment in this area need a basic knowledge of mathematics along with good English skills. Accuracy in measurement and correct placement of type are also necessary since errors are costly.

Most opportunities for employment and advancement are through apprentice-ship training of approximately five years. Applicants are for the most part high school graduates. High schools, technical vocational institutes and colleges offer printing courses and completion of such studies can help a person gain easier admission into an apprenticeship program.

The following kinds of mathematics problems are examples of those which a printer would probably be asked to solve.

Activity

1. A cylinder press can print 5,000 sheets per hour at a cost of $25.75 per hour. What is the cost of printing 3,000 sheets?

2. A flat-bed cylinder press can print and cut 800 cartons per hours. How long will it take to print and cut 22,000 cartons?

3. The point and the pica are the units used by printers in all English speaking countries. The point system is used to measure type sizes, to mark copy and to measure distances in printed matter. A point measures .01384" or approximately 1/72 of an inch. Thus, there are 72 points to one inch. One pica is approximately 1/6 inch or 12 points. This paper is printed using pica type. How many letters fit into 6 picas? How many letters fit in one pica space?

4. Since there are 6 picas in one inch, how many inches long is a 39-pica line? How many inches long is a 23-pica line?

5. A sports article has a copy with a width of 54 picas and a depth of 78 picas. Find the area, in square inches, of this story. Hint: Change the width and depth to inches first.

6. The point and the pica are units of length used by printers, but the em is the unit of area. An em is the area occupied by the capital letter M in any given type size. It is always a perfect square. As the point size of the type varies, the size of the em also varies. How many ems of 8-point type are there on a page with type set 288 points wide and 504 points deep? Draw and label the rectangle allotted for this space.

7. There are 4 main classes of type:
   Roman
   Sans Serif
   Script
   Black Letter

   Each class contains several hundred different type sizes and styles. Using an encyclopedia and tracing paper, neatly trace one example of each class of type. Which style of type is most commonly used?

ANSWERS:

1. $15.45

2. 27.5 hours

3. 12, 2

4. 6.5" . 3 5/6"

5. 117 sq. in.

6. 2,268 ems, rectangle 4" x 7"

7. Baskerville

SKILL AREAS:

Whole Numbers: multiplication and division (divisor to 3 digits)

Ratio and proportion

Measurement: English System

CONSTRUCTION

CLUSTER

Architect/Architectural Technician
Electrician
Roofer

Construction Cluster

ARCHITECT/ARCHITECTURAL TECHNICIAN

The planning of a structure for construction begins with the work of the architect and the assistants, the architectural technicans. The work of these individuals involves an intensive knowledge of the mathematical areas of geometry, algebra and calculus. Students should be aware of the professional training necessary for this career area.

The preparation of specifications, construction of small models and the layout design of the building site are duties performed by architectural assistants. These assistants must have a working knowledge of dimension and building, must be aware of state, county and municipal building codes and blueprints must reflect these official specifications.

The following activity will enable the student to simulate these technical skills: mechanical drawing, blueprint designing and structural dimension.

Activity

This is an example of architectural drafting. Select the measurement system which you prefer.

Dimensions: one story ranch home

Room	English	Metric
Living Room	13' x 20'	4m x 6.5m
Dining Room	13' x 13'	4m x 4m
Master Bedroom	13' x 18'	4m x 6m
Bedroom	12' x 12'	3.5m x 3.5m
Bedroom	12' x 15'	3.5m x 5m
Bathroom	6' x 8'	2m x 2.5m
Recreation Room	13' x 20'	4m x 6.5m
Kitchen	12' x 16'	5m x 4m
Powder Room	6' x 8'	2m x 2.5m
Laundry Room	6' x 11'	2m x 3.5m

With the above dimensions and the scale of $\frac{1}{4}$" = 1' or 3cm = 1m, design this one story ranch home using a large piece of oaktag or construction paper. Suggestion: From paper cut one rectangle for each room. Position each rectangular room as desired. Then complete the final scale drawing on a separate piece of paper.

ANSWERS:

Students homes will vary in design.

SKILL AREAS:

Scale drawing

Ratio and Proportion

Construction Cluster

ELECTRICIAN

Our modern society is quite dependent on electricity. Much has been learned about electricity since it, as a form of energy, was discovered. The number of related professions, trades, technicians, laborers, etc. in the field of electronics is quite large and the various industries directly dependent on electricity and electronic technology would indeed be all inclusive.

The objective of this lesson is to give you some fundamental notions as to how to measure electric current. No, you have not read incorrectly since electricity must be measured. Although we cannot see electricity, we do know of its existence and it can be measured.

The first fundamental idea we encounter is a resistor (as the name implies, they resist the flow of electrical current). At times resistors are placed in series in an electrical circuit. This simply means that they are placed one after the other (see fig. 1).

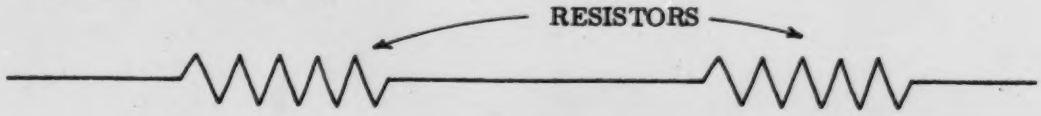


fig. 1

When electricians show an electric circuit, they draw what is called a schematic of the circuit. The straight line in fig. 1 represent the wires and the broken line (/\/\/\ ) represents a resistor. Figure 1 shows only part of a schematic.

Activity

To find the total resistance R_t of resistors in a series connection, the electrician simply finds the sum of all resistors in the circuit. The formula is:

$$R_t = R_1 + R_2 + R_3$$

Three resistors are wired in series in a direct current (D.C.) power line to drop the voltage to an electric boiler. R_1 = 15 ohms (ohms is the unit measure for resistance), R_2 = 25 ohms, R_3 = 18 ohms and R_4 = 30 ohms.

What is the total resistance?

$R_t = R_1 + R_2 + R_3 + R_4$

$R_t = 15 + 25 + 18 + 30$

$R_t = 88$

Conclusion: the total resistance is 88 ohms

Solve the following:

1. Five resistors are wired in series across the output of a D.C. generator to act as voltage dividers. Find the total resistance, if R_1 = 35 ohms, R_2 = 30 ohms, R_3 = 27 ohms and R_4 = 42 ohms.

2. To allow for the proper voltage drop a total resistance, R_t of 130 ohms is needed. What is the value of the fourth resistor, if R_1 = 38 ohms, R_2 = 45 ohms and R_3 = 25 ohms?

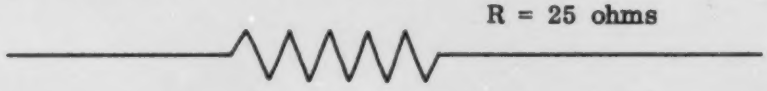
3. Suppose you were required to wire three electric light bulbs in series. Each of the lamps has a resistance of 23 ohms. You also connect a 45 ohm resistor in series with the lamps. What is the total resistance?

A formula which is used many times in electrical work is E = I x R (called Ohm's Law). This means if you know the amount of current (I) and multiply it by the resistance (R), the product will be the voltage. Voltage is also known as electrical pressure, electromotive force, or EMF.

Unit measure for current, I, is amperes
Unit measure for resistance, R, is ohms
Unit measure for voltage, E, is volts

What is the voltage drop across a resistor if the resistance is 25 ohms and the current is 10 amperes (see fig. 2)?

R = 25 ohms

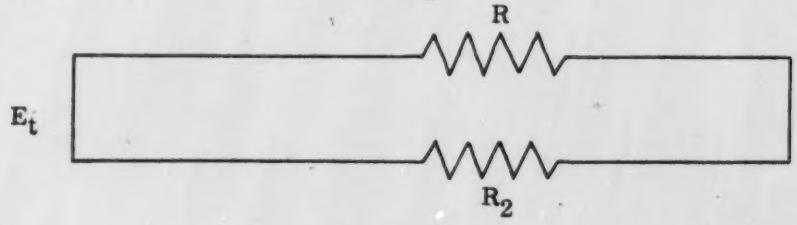


$E = I \times R$
$E = 10 \times 25$
$E = 250$

Conclusion: the voltage drop is 250 volts.

Two resistors R_1 and R_2 are connected in series and across a D.C. voltage source in order to supply different voltages to a distribution panel. What is the voltage drop across each resistor if R_1 = 22 ohms, R_2 = 30 ohms and I = 6 amperes.

What is the total voltage if $E_t = E_1 + E_2$?



$E_1 = I \times R_1$ $\qquad$ $E_2 = I \times R_2$

$E_1 = 6 \times 22$ $\qquad$ $E_2 = 6 \times 30$

$E_1 = 132$ $\qquad$ $E_2 = 180$

$E_t = E_1 + E_2$

$E_t = 132 + 180$

$E_t = 312$

Conclusion: The voltage drop across R_1 is 132 volts.
The voltage drop across R_2 is 180 volts.
The total voltage is 312 volts.

4. Three resistors are series connected similar to example two. R_1 = 28 ohms, R_2 = 23 ohms and R_3 = 35 ohms. The current is 6 amperes.

   a. What is the voltage drop across each resistor?

   b. What is the total voltage?

   c. What is the total resistance in the circuit?

   d. Can you find the total voltage without finding each voltage drop?

You can calculate the power by multiplying the current by itself and then multiplying again by the value of the resistance. If P represents the power, measured in watts, then P = I x I x R. Since E = I x R, then P = I x E is another formula to find power.

An electric toaster whose hot resistance is 12 ohms has a current of 9 amperes flowing through it. How much is being used?

$P = I \times I \times R$ or $E = I \times R$

$P = 9 \times 9 \times 12$ $E = 9 \times 12 = 108$

$P = 972$ watts $P = I \times E$

$P = 9 \times 108$

$P = 972$ watts

Conclusion: The measure of power is 972 watts.

5. What is the power of an electric motor taking 10 amperes on a 220 volt line?

6. An electric drill takes 4 amperes at a voltage of 120. What is its power?

7. An automobile engine starter takes 300 amperes at 12 volts and what is its power?

8. An electric motor running on a 220 volt line takes 30 amperes. What is its approximate horsepower? One horsepower equals 746 watts, therefore, Horsepower (hp) $= \frac{\text{watts}}{746} = \frac{E \times I}{746}$.

$hp = \frac{E \times I}{746}$ $hp = \frac{220 \times 30}{746} = \frac{6600}{746}$ $hp = 8.8$

Conclusion: The motor is approximately a 9 hp motor.

9. Find the hp of the motor in problem 5.

10. Find the hp of the drill in problem 6.

11. Find the hp of the starter in problem 7.

12. Find the amperes necessary to run the following household appliances on 120 volts.

a. a 120 watt bulb

b. a 720 watt toaster

c. a 1080 watt motor

d. a 200 watt bulb

e. a 360 watt fan

ANSWERS:

1. 134 ohms

2. 22 ohms

3. 114 ohms

4. a) 168, 138, 210
   b) 516 volts
   c) 86 ohms
   d) Yes, multiply total resistance by 6

5. 2200 watts

6. 480 watts

7. 3600 watts

8. 3 hp (2.9)

9. 1 hp (.64)

10. 5 hp (4.8)

11. a) 1
    b) 6
    c) 9
    d) 1.7
    e) 3

SKILL AREAS:

Whole Numbers: addition, subtraction, multiplication and division (divisor up to 3 digits)

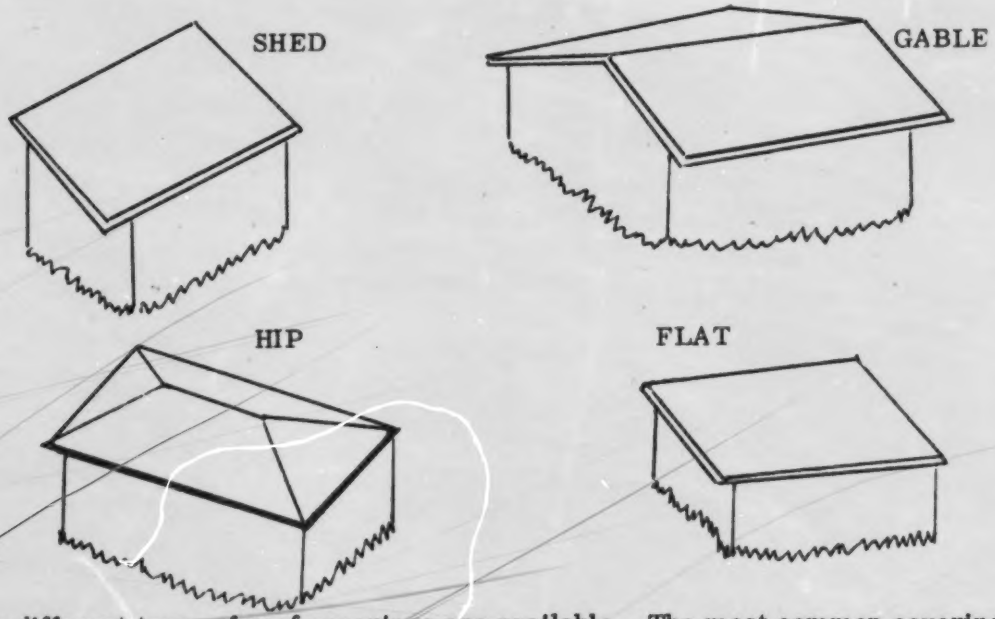
Construction Cluster

ROOFER

Many of us have watched the construction of a house at different stages. We come to realize the complexity of the total construction work and the many different types of skills that are needed. Carpenters, electricians, plumbers, roofers, painters, masons, elevators, architects and many more. The list is quite long and each specialty, when working as part of a team, produce the finished product.

One of the construction team, the roofer, is knowledgeable in the materials most appropriate for the building. The roofer recommends the shape of the roof and estimates the cost for its construction. You can see basic mathematics are needed in this career area.

Take a look as you return home today at the variation in the shapes and sizes of the roofs on the houses you pass. The shapes of roofs generally fall into one of the four basic categories: shed, gable, hip, and flat (see diagrams below):



Many different types of roof coverings are available. The most common coverings are: asphalt, asbestos, and wood shingles. Asphalt shingles appear to be most in use in modern home building. They may be purchased in many different colors, however, white and black are most common. Asphalt shingles are purchased in bundles, however, the unit measure is a "square". One square of shingles will cover 100 square feet of roof. Three bundles constitute one square of shingles. Hence for every 100 sq. ft. of roof one needs to purchase one square of shingles (or 3 bundles). An additional 5% more of shingles are purchased to allow for waste and over peaks.

A layer of roofing felt is placed on the roof before a roofer puts down the shingles. Roofing felt comes in rolls of 3 foot widths and 144 foot lengths. Therefore, one roll will cover 3' x 144' or 432 square feet.

In addition to shingles and felt, a roofer needs nails to attach the shingles to the roof. Approximately 2 pounds of nails should be allowed for one square of shingles.

Have you ever been curious about the planning and the cost involved in putting a roof covering on your home? The following will give you some idea of the problems roofers have when facing a new job.

Activity

1. How many squares of asphalt shingles does it take to cover 2 sides of a gable roof whose length is 28 feet long and a rafter length (length from peak to edge of the roof on one side) of 18 feet (assume no waste).

2. All of the following parts relate to problem 1 above.

    a. How many bundles of shingles are needed?

    b. How much would be spent on the shingles if a square of shingles cost $15.00?

    c. How many pounds of nails need to be purchased if you only purchase whole pounds of nails?

    d. If each bundle weighs 80 pounds, how many pounds does a square of shingles weigh?

3. What is the cost of roofing materials for a 2160 square foot roof? Assume that shingles cost $6.00 per bundle, roof felt costs $3.00 per roll and nails are $.95 per pound.

4. Discuss, with your mother or father, the roof of your house.

    a. Determine the type of roof on your house.

    b. Ask your parents for the measurement of the roof on your house.

    c. Determine the cost of roofing the roof of your house by using the prices in problem 3. Give dimensions of your roof, sketch the roof and show all work.

ANSWERS:

1. 11 squares

2. a) 33 bundles
   b) $165.00
   c) 22 pounds
   d) 240 pounds

3. Need 21.6 squares or 64.8 bundles

64.8 + 5% of 64.8	=	68.04 or 68 bundles
Cost for bundles	=	$408.00
Cost for roof felt	=	15.00
Cost for nails	=	41.80
TOTAL	=	$464.80

4. Answers will vary.

SKILL AREAS:

Whole Numbers: multiplication, division (divisor of 3 digits)

Decimals: addition, multiplication

Percent: finding percent of a given number

Area: rectangle

CONSUMER AND HOMEMAKING

CLUSTER

Budget Consultant
Dietician
Market Research Analyst

Consumer and Homemaking Cluster

BUDGET CONSULTANT

In order to live comfortably within one's financial means, any individual or family must consider the budgeting of their money. There are professional budget consultants who can give advice to consumers concerning any budget planning problems. Since every personal budget varies depending on one's expenses and needs, the computing of this financial plan will change accordingly. It is apparent, therefore, that anyone interested in this career area should have a sound mathematics background and good logic reasoning ability. A budget consultant must also be tactful and personable as he/she advises clients concerning their personal financial questions.

This professional must be in contact with local, county and state special service agencies in order to advise individuals as to where they might seek welfare or relief services if necessary. In New Jersey the Department of Social Services also employs its own budget consultants in the Division of Welfare.

The budget consultant's primary responsibility is actual budget planning for the individual or family requesting this service. The following activity will give you an idea of what is involved in budget planning. You will work with figures which would be of real concern to a budget consultant.

Activity

Complete this typical budget. Compute the dollar amount for each item in the budget by using the given percents. Then compute the 2 missing percents to the nearest whole percent. This budget covers a time period of one month.

Budget Items	Dollar Amount	Percent of Total
Rent or Mortgage	$ 300	?
Food	?	22
Personal Insurance	?	3
Utilities:		
Gas	36	?
Electric	?	2
Telephone	?	2
Recreation	?	5
Clothing	?	8
Transportation (car, insurance, maintenance, buses)	?	11
Medical	?	5
Savings	?	5
	$ 910	100

2. (a) What is this family's yearly income?

   (b) Suppose the family income increases to $980.00 per month. How much extra money must now be added to the budget?

   (c) What is the percent increase in this family's monthly earnings?

   (d) Where in the budget would you incorporate this "new" money?

3. Suppose that you have a newspaper route which earns you $22.00 per week. Make a weekly budget which is realistic for you.

ANSWERS:

	Dollars	Percent
Rent or Mortgage	---	33
Food	$200	---
Personal Insurance	27	---
Utilities:		
Gas	---	4
Electric	18	---
Telephone	18	---
Recreation	46	---
Clothing	73	---
Transportation (car, ins., main., buses)	100	---
Medical	46	---
Savings	46	---

2. a) 10,920
   b) 70
   c) 7.7%
   d) Will vary

3. Will vary

SKILL AREAS:

Whole Numbers: subtraction, multiplication

Percent: finding what percent one number is of another, finding percent of a number

Consumer and Homemaking Cluster

DIETICIAN

The professional dietician provides a valuable consumer service. This person's responsibility demands expertise in the sciences of nutrition and food management which includes thorough understanding of weights and measures, caloric value and special diets. The dietician's work involves the application of this knowledge for the betterment of individuals and groups.

Many dieticians serve in hospitals. However, about half of these professionals direct the food services in schools and colleges, commercial and industrial facilities, health and welfare agencies.

In addition to the mathematics and science training for this career, the individual should appreciate personal contact and involvement with the public. This eagerness to serve the personal needs of the public promises a rewarding career area.

Activity

The hospital dietician is responsible for the development of special diets for those patients needing nutritional guidance. The ulcer patient usually requires a "bland diet"; the heart patient usually requires a "low sodium" or "restricted cholesterol diet"; the diabetic patient usually requires a "restricted calorie diet".

Suppose you as a dietician must develop a menu for a diabetic patient needing 1500 calories. The diet must include foods from the seven basic exchange lists in order to be certain that the patient receives the proper intake of calories, carbohydrates, proteins and fats. For this purpose, the dietician has organized the nutrition needed into three meals: breakfast, lunch and dinner.

Breakfast	Lunch	Dinner
1 fruit exchange	2 meat exchanges	2 meat exchanges
2 bread exchanges	2 bread exchanges	2 bread exchanges
1 meat exchange	1 fruit exchange	2 vegetable exchanges
2 fat exchanges	1 milk exchange	1 fruit exchange
½ milk	1 fat exchange	½ milk
		1 fat exchange

1. The dietician must now develop the meals according to the seven Exchange Lists. However, the patient refuses to eat any green vegetables, will not drink milk at meals and loves coffee with milk and sugar. Since sugar is forbidden on any diabetic diet, the doctor has allowed only sugar substitutes that have no nutritional nor caloric value. Using the limited seven exchange lists below, create one day's meals for this patient.

   Then compute the exact number of calories.

   Complete this information in simple chart form so that the patient would find it easy to follow:

List 1: Allowed as Desired

- Sugar Substitutes
- Black Coffee
- Tea
- Pickles
- Asparagus
- Cauliflower
- Lettuce
- Radishes
- Tomatoes
- Peppers
- Mushrooms

List 2: Vegetables Exchange
(½ cup serving at 36 calories)

- Beets
- Carrots
- Onions
- Green Peas
- Pumpkin

List 3: Fruit Exchange
(1 portion at 40 calories each)

- 1 Small Apple
- ½ Small Banana
- 2/3 cup Blueberries
- 10 Large Cherries
- 12 Grapes
- 1 Small Orange
- ½ Cup Pineapple
- 1 Large Tangerine
- 1 Cup Watermelon

List 4: Bread Exchange
(each portion at 68 calories)

- 1 Slice Bread
- 1 Small Biscuit
- 1 Slice Cornbread
- ½ Cup Cooked Cereal
- ½ Cup Rice
- ½ Cup Spaghetti
- ½ Cup Mashed Potatoes
- 5 Saltine Crackers
- 1/3 Cup Corn
- 1 Medium Baked Potato
- ¼ Cup Sweet Potatoes
- 1½ Cube of Plain Sponge Cake

List 5: Meat Exchange
(each portion supplies 73 calories)

- 1 Slice of Meat or Poultry (3" x 2" x 1/8")
- 1 Slice Cold Cuts
- 1 Frankfurter
- ¼ Cup Tuna, Crab or Salmon
- 5 Small Shrimp, Clams or Oysters
- 1 Slice American Cheese
- ¼ Cup Cottage Cheese
- 1 Egg

(continued)

List 6: Fat Exchange
(each portion supplies 45 calories)

1 Teaspoon Butter or Margarine
1 Slice Bacon
1 Tablespoon of Cream Cheese
1 Teaspoon of Mayonnaise
6 Small Nuts

List 7: Milk Exchanges
(each portion supplies 170 calories)

1 Cup Whole Milk
½ Cup Evaporated Milk
1 Cup Buttermilk

2. Dieticians do not all work in hospitals. Many dieticians direct the food service in educational institutions or in commercial and industrial organizations. For an elementary school, the dietician develops lunch menus that are high in carbohydrates and proteins as well as pleasing to student appetites. This person also supervises the costs of buying foods in quantity, the preparation and its distribution. Below is a typical menu for schools mainly subsidized by the government. Using the preceding exchange lists, compute the number of calories for Lunch A. Does this menu encompass the seven exchange lists?

Is this lunch a well-balanced one?

Lunch A

1 Piece of Cornbread
1 Pat of Butter
1 Cup of Whole Milk (½ pint container)
1 Medium Portion Baked Chicken
½ Cup Mashed Potatoes
½ Cup Green Peas
Lettuce and Tomato Salad (plain)
1 Small Orange

Lunch B, given below, is an all-time favorite. Since it is not all federally funded, the school must provide the food stuffs. The school dietician is responsible for the food budget. About 350 students will buy Lunch B. Figure the total cost of feeding the students.

Lunch B

Hamburgers ..... 12½ cents each
Hamburger Rolls ..... 4 cents each
French Fries (subsidized by the gov't)..... No cost
String Beans..... $1.25 for 50 servings
Milk (½ pint containers)..... 3 cents each
Ketchup - 1 Case used at..... $12.50 per case
Napkins and Straws ..... 75 cents for 350 students

ANSWERS:

1. Answers will vary according to food exchange lists.

   1485 calories

2. Lunch A: 500 calories Yes Yes

   Lunch B: $100.75

SKILL AREAS:

Whole Numbers: addition

Decimals: multiplication, addition

Consumer and Homemaking Cluster

MARKET RESEARCHER

To help evaluate consumer products to determine customer satisfaction with a particular product or service and to project consumer demands, the services of market research individuals are needed. These persons use the facts and figures from public surveys to advise companies of potential sales. The collection and analysis of this data is usually done by market researchers, then presented by the market research analyst at executive meetings of the particular company. Very often the future success of a company depends upon the accurate work of the public market researcher and analysis of these results. In the competitive business world, companies need to know all they can about the public's reaction to the product or services.

To prepare for careers in market research, high school courses in advanced mathematics such as algebra, statistics, geometry and computer technology are important. A bachelor's degree in economics, marketing or business is necessary for employment. Because of the use of questionnaires, a person would be wise to study social science areas for a good background for working with the public.

Taking questionnaires with large amounts of information and sifting down to understandable figures for the company requires a talented individual. This person's analysis of consumer information is very important to a company.

Activity

Pretend you are a market researcher and have been employed to determine town sentiment in regard to the selling of a 5 acre tract of land for development. There has been much controversy concerning how this land should be used. So far three bids have been received:

1. a major corporation that is claiming to stabilize your property tax rate.

2. the municipal governing body for use as recreational facilities

3. a medical group composed of doctors for family practice.

Survey at least 15 people making sure to survey at least 3 consumers in each age group. Gather your information using the chart on the following page.

Your teacher will help the class compile all the data. Then complete the chart below.

		Corporation		Municipality		Medical Group		Totals	
		No.	%	No.	%	No.	%	Total Number	Total %
SEX	Male								
	Female								
AGE	Under 21 yrs								
	21-40 years								
	41-64 years								
	Senior Citizens								
STATUS	Property Owners								
	Renters								
	Students								

Based on this survey, which decision should the town make? Give reasons for your answer.

	SEX		AGE GROUP				COMMUNITY STATUS			LAND
Consumer	Male	Female	Under 21	21-40	41-64	Senior Citizens	Property Owner	Renter	Student	CHOICE
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										

ANSWERS:

Answers will vary.

SKILL AREAS:

Percents: finding percents

Gathering data

ENVIRONMENT

CLUSTER

Environmental Scientist
Meteorologist/Weather Consultant
Sound Crew Person/Accoustical Technician

Environment Cluster

ENVIRONMENTAL SCIENTIST

All people are seriously concerned about the dwindling resources and the endangered wildlife of our environment. With such a vast populated world our precious and limited natural environment must be protected and preserved. As a result of this seemingly overwhelming problem, there are many people whose employment by the federal, state and municipal government involves them working to solve the environmental crisis.

One such concerned occupation is that of the environmental scientist. These scientists are highly skilled professional engineers employed to program and direct the anti-pollution efforts of environmental protection services. Because of the need for technologists in all environmental areas, including water, air and land pollution, the environmental scientist must specialize in one of these fields.

A great many statistical figures and projections must be computed by these professionals. Therefore, a thorough science and mathematics background is mandatory for this career area. The following activity will familiarize you with some of the concerns of the environmental scientist.

Activity

1. Environmental scientists estimate that 400 million gallons of raw sewage from apartments and companies on the west side of New York City is dumped into the Hudson River daily. These engineers have designed sewage treatment centers to clean up the Hudson River. One of these centers in operation can chemically treat 200 million gallons per day.

    a) At this rate, how much sewage is dumped into the Hudson over a two week period?

    b) How much can be handled by the treatment centers?

    c) What percentage of the raw sewage is treated?

2. Federal government construction grants totaling $10 billion dollars have been designated for water treatment centers. New Jersey has applied for money ranging from $500,000 to $75 million for 50 water treatment centers.

   What is the minimum and maximum costs for one water treatment plant requested by New Jersey?

3. Environmental scientists are concerned with the 400 million gallons of raw sewage being dumped into the Hudson. The primary treatment removes 200 million gallons of dirt and bacteria. These engineers have designed secondary treatment operations which remove 85% of the remaining bacteria and dirt.

   How many gallons are removed during the secondary treatment?

ANSWERS:

1. a) 5600 million
   b) 2800 million
   c) 50%

2. minimum - $10,000
   maximum - $1,500,000

3. 170 million gallons

SKILL AREAS:

Whole Numbers: multiplication, division (divisor to 2 digits)

Changing fractions to a percent

Percent: finding the percent of a given number

Environment Cluster

METEOROLOGIST/WEATHER CONSULTANT

Meteorologists study the earth's atmosphere and its effects on weather. Many of these scientists also attempt to predict the weather.

Advanced mathematics courses are an important part of a college meteorology program. Therefore, the middle school student should not only enjoy mathematics, but also succeed in this subject.

In this career area are a number of different specialities:

1. Climatologists study records of weather conditions over long periods of time. General conclusions can then be made in terms of an area's climate.

2. Dynamic meteorologists study laws of motion of the atmosphere.

3. Physical meteorologists study the nature of the atmosphere.

4. The synoptic meteorologist is the specialist with whom we are most familiar. She/he is the weather forecaster who examines and analyzes such atmospheric conditions as high and low pressure areas, winds, and temperature. Important in his/her work are reports from observers and information from weather satellites. With all this important data an honest effort is then made to predict the weather.

Some weather forecasters work for television and radio stations and in many cases broadcast their own predictions. Other people in this occupation are sometimes employed by the federal government, private industries, as well as colleges.

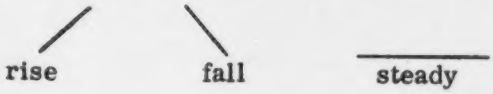
Activity

To insure uniformity in the observations and the reporting procedures throughout the world, a set of definitions, scales, standards and codes were adapted in the 1950's by international agreements.

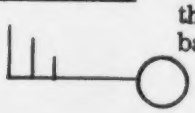
Instrument readings (i.e. pressure, temperature) and visual observations (i.e. types of clouds, rain and snow) are transmitted to all forecasting centers, where the instrument readings and visual observations are graphically represented on a "weather chart". These weather charts contain a great deal of information at a glance, provided a person knows the symbols used and their location on the chart. Some important symbols are listed for reference at the end of this activity. Study the following example to see how a weather forecaster reads a weather chart.

SOME IMPORTANT SYMBOLS IN WEATHER FORECASTING

Barometric Symbols for a 3-hour period preceding observation



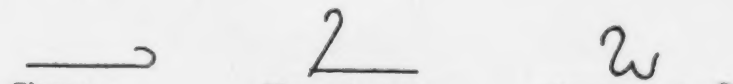
Wind Direction and Speed The shaft of the arrow indicates the direction and the barbs indicate wind speed in knots. Long barbs represent 10 knots, short barbs 5 knots.



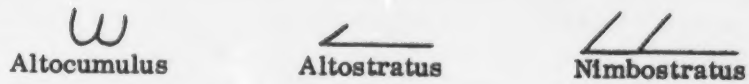
Amount of Sky Covered by Clouds

Cloud Forms

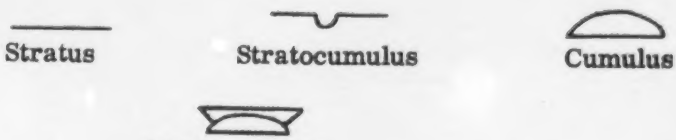
High Clouds:



Middle Clouds:



Low Clouds:



Precipitation and Impurities

Fog

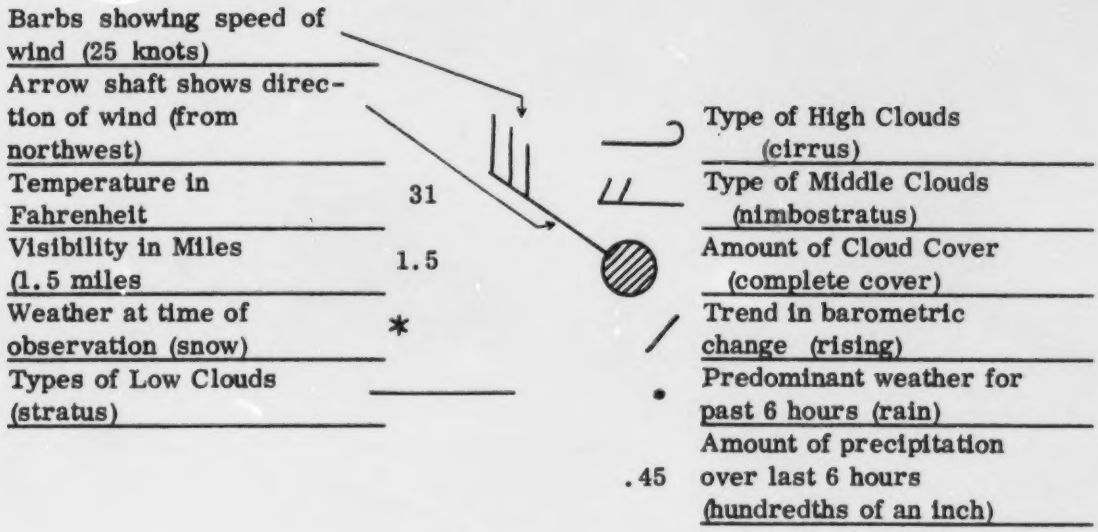
Snow

Haze

Rain

Flurries

Thunderstorms


Barbs showing speed of wind (25 knots)
Arrow shaft shows direction of wind (from northwest)
Temperature in Fahrenheit
31
Visibility in Miles (1.5 miles
1.5
Weather at time of observation (snow)
*
Types of Low Clouds (stratus)
Type of High Clouds (cirrus)
Type of Middle Clouds (nimbostratus)
Amount of Cloud Cover (complete cover)
Trend in barometric change (rising)
Predominant weather for past 6 hours (rain)
.45
Amount of precipitation over last 6 hours (hundredths of an inch)

The following "weather charts" use only the symbols on the list provided. Answer the questions using the list and the above example and you will gain some understanding of that part of a meteorologist's job which involves gathering and representing weather data. While solving the following problems, it is important to use the positions in the above example.

1. Using the sample problem as a guide, state the 12 weather conditions pictured in weather chart A. Do the same for weather chart B.

Chart A

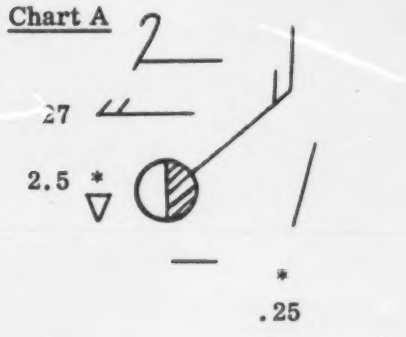
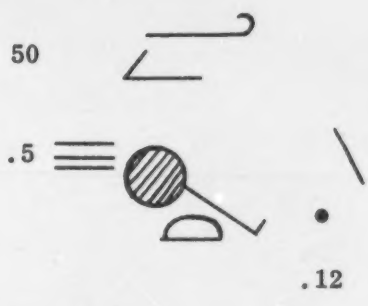


Chart B



2. Construct the weather chart for the conditions described below:

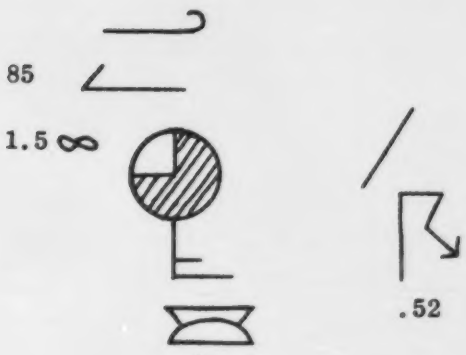
At the time of observation there is haze and thundershowers have been prevalent. The precipitation accumulation has been .52 inches, and the barometer is rising with a 75% cloud cover.

Temperature - 85 degrees
Visibility - 1.5 miles
Wind from the south at 15 knots
High clouds - cirrus
Middle clouds - altocumulus
Low clouds - cumulonimbus

ANSWERS:

1.	CHART A	CHART B
High Clouds	Cirrostratus	Cirrus
Middle Clouds	Nimbostratus	Altostratus
Low Clouds	Stratus	Cumulus
Temperature	$27^{o}F$	$50^{o}F$
Visibility	$2\frac{1}{2}$ miles	$\frac{1}{2}$ mile
Present Weather	Snow Flurries	Fog
Cloud Cover	$\frac{1}{2}$	Full
Weather for past 6 hours	Snow	Rain
Barometer	Rising	Falling
Wind Direction	From North East	From South East
Wind Velocity	15 mph	5 mph
Precipitation past 6 hours	$\frac{1}{4}$"	3/25"

2.



SKILL AREAS:

Changing percents to fractions

Construction of a chart

Environment Cluster

SOUND CREW PERSON/ACOUSTICAL TECHNICIAN

Noise pollution has recently become a very serious concern of the general public as a result of the Concorde SST controversy. During the last few years increased airplane noise has caused some citizens to demand new take-off and landing patterns, but now the roar of the supersonic transport has more people focusing on this issue. This new plane is flying regular routes between Washington and Paris-London. However, this aircraft's noise levels have prevented its landing at most national airports.

A number of different citizen groups as well as governmental agencies are involved in monitoring and/or regulating airplane noise levels. State and municipal governments have personnel assigned to this work. The U.S. Environmental Agency and Federal Aeronautics Administration are involved in this area as well.

The Port Authority of New York-New Jersey regulates and manages the three major metropolitan airports: Kennedy, La Guardia, and Newark. Part of this authority's concern is also airplane take-off noise limit. Specialized psychologists and acoustical experts are involved in this work. Sound crew personnel are assigned on extended line runways. Using highly sensitive sound equipment, these individuals monitor and record noise levels which must not exceed certain sound limits.

Individuals employed as sound crew persons need a good knowledge of basic mathematics and must be responsible for on-the-job training. The employment opportunities in this area are expanding since new airplane noise designs and public government concerns are sometimes at odds and constant monitoring and research seem inevitable.

Activity

1. Make a tape recording of at least 10 sounds of varying noise levels. Give each sound a number but do not identify it on the tape. For instance, sound one (vacuum cleaner), sound two (rock music), sound three (motorcycle), etc. Prepare a rating sheet like the one below so that each person can keep a written account of his/her responses. Divide the group you interview into Group A and Group B. Each person will listen to the entire tape and have each sound rated as to noise level, using the scale 1 to 5 indicated on the following rating sheet. Select 10 classmates and have them listen to the tape and fill out a rating sheet.

RATING SHEET

NAME_____(Group A or B) DATE_____

1 not noisy	2 slightly noisy	3 moderately noisy	4 very noisy	5 extremely noisy

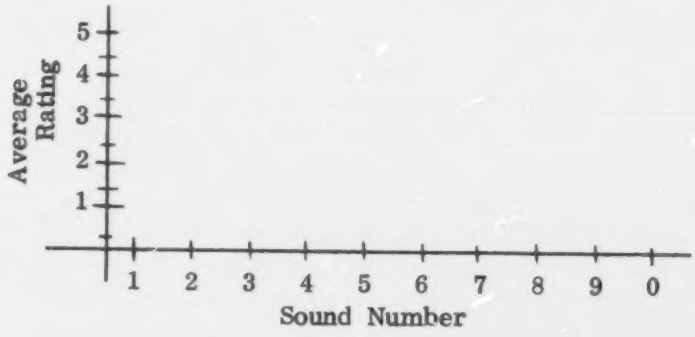
Choose one number above to rate the sounds you hear on the tape.

a. Compute the average rating for each sound for all students.

b. Compute the average rating for each sound for Group A students.

c. Compute the average rating for each sound for Group B students.

3. Make a bar graph using the results of part (a) above.



4. Make a line graph showing the results of part (b) and (c) above. Show the graph for Group A in red and the graph for Group B in blue. Use the same vertical and horizontal axes as in the example above.

5. The acoustical personnel of the Port Authority concern themselves with all airplane data available. The following problems are to give more information on the Concorde.

   a. The Concorde flies at twice the speed of sound. If this speed is 1080 feet per second, how fast in miles per hour does the Concorde fly? Round off your answer to the nearest whole number.

   b. Subsonic jet planes cruise at an average of 550 mph. The cruising speed of the Concorde is 1450 mph. How many times faster is the Concorde?

c. The passenger limit on the Concorde is one-third the capacity of the regular jet. If the Concorde carries 112 passengers, then what is the seating capacity in a normal jet?

d. The manufacturing cost for each Concorde is $31 million. This is eight times the cost of a subsonic jet plane. What is the cost of a subsonic jet?

e. Between Washington and London, the ticket fare for the Concorde will be 20% over the current first-class fare of conventional airlines. The current rate for conventional airlines is $1333. What will be the ticket price for the Concorde?

6. Noise levels are the major concern of the sound crew persons. Sound intensity is measured in decibels, abbreviated as db. The chart below lists some typical noise levels:

low whispers	1 db
chewing gum	20 db
quiet home	40 db
loud radio	85 db
diesel electric generator	90 db
thunderclap	100 db
circular saw	110 db
normal jet 100' away	125 db
riveting on steel plates	130 db
Concorde SST	250 db

Government studies suggest ear protection for noise levels exceeding 90 decibels. Exposure to noise above 97 db for more than three hours daily or over 115 db for 15 minutes daily may lead to a hearing loss.

A sound of 10 db transmits 10 times as much energy as a 0 db sound; a sound of 20 db transmits 100 times as much as a 0 db sound; a 30 db sound transmits 1000 times as much energy. The pattern continues, using the powers of 10, as long as is needed. Using the chart above, find the energy transmitted between the objects below. Express your answers in whole numbers and then in exponential form using powers of 10.

a. between chewing gum and a quiet home
b. between a thunderclap and a circular saw
c. between a thunderclap and riveting on steel plates
d. between a quiet home and a circular saw
e. between a diesel electric generator and riveting on steel plates
f. between riveting on steel plates and the Concorde SST (Give the name for this large number.)

ANSWERS:

1. Will vary

2. Will vary

3. Will vary

4. Will vary

5. a) 1473
   b) 2.63
   c) 336
   d) 3,875,000
   e) $1599.60

6. a) $100 = 10^2$

   b) $10 = 10^1$

   c) $100 = 10^2$

   d) $10,000,000 = 10^7$

   e) $10,000 = 10^4$

   f) $1,000,000,000,000 = 10^{12}$ = one trillion

SKILL AREAS:

Whole Numbers: addition, multiplication, division (divisor up to 4 digits)

Averaging

Powers of 10

Finding the percent of a given number

Bar and line graphs

FINE ARTS

AND

HUMANITIES

CLUSTER

Film Processor
Model Maker
Photographer

Fine Arts and Humanities Cluster

FILM PROCESSOR

Many people do not realize the technical work involved in the process between the photographer's skills and the final snapshot. Film processing requires not only artistic skill but also technical training. Often the desired and end-product, a finished professional photograph, is the result of the careful work of the film processor. The work involves the careful development of the photographer's exposures. They must have a thorough knowledge of the chemical solutions for developing prints. Perhaps the need is for a larger or smaller finished print. It is the film processor who can successfully complete this assignment. This reduction or enlargement process in photography demands that the individual can estimate proportional size. The film processor often works as a layout designer, in that once the space for the photograph is determined, the layout designer can determine what changes need to be made from the original size to produce a pleasing layout.

Activity

To determine the size of a photograph, the film processor uses proportion. The ratio of the width and depth of the original photo must be equal to the ratio of the width and depth of the enlargement or reduction requested by the customer or layout designer.

$$\text{Formula: } \frac{\text{Original Width}}{\text{Original Depth}} = \frac{\text{Final Width}}{\text{Final Depth}}$$

1. A layout designer has requested that a 5 x 7 photograph be reduced to fit on a space with a width of $3\frac{1}{2}$". Determine the depth of the final photograph.

2. An advertising firm has requested that an 8" x 10" photograph be reduced to fit within a space having a width of 2 5/8". Find the depth of the final photograph. Round your answer off to the nearest tenth.

3. A film processor must enlarge a 4" x 5" photograph to an 8" x 10" photograph. In area, how many times larger is the new photograph?

4. The film processor wants to enlarge a 4" x 5" photograph so its dimensions are 80% of the original. What are the new dimensions?

A film processor deals with chemical solutions in the development of film. Two important solutions in this process are the stop bath and the fixing bath (hypo).

5. For the stop bath solution, the processor needs to mix 1.5 ounces of 28% acetic acid in 32 ounces of water. This yields 33.5 ounces of solution. If the processor wants only half of this amount, how much 28% acetic acid and how much water must be used?

6. The fixing bath (hypo) solution consists of 4 ounces of hyposulfite soda to 20 ounces of water. What percent of the fixing bath solution is hyposulfite of soda? Round your answer to the nearest tenth of a percent.

7. Many film processors become involved with microfilm. Microfilm can be used for newspapers, bound volumes, and loose-leaf material. Material is photographed, then reduced in size, often to 1% in area of the original and put on strips of 16 mm or 35 mm non-flammable safety film, usually 100' rolls. Desk projectors return normal size or a maximum of $1\frac{1}{2}$ times the original area.

   The U.S. Bureau of Census is one of the largest users of microfilm. Census documents bound in huge 25-pound ledgers, occupy miles of shelving and cover thousands of square feet of floor space. Microfilm saves up to 95% in floor space for duplicating this material.

   Libraries can reduce 10 issues of the New York Times averaging 830 pages on a single 100' roll of 35 mm film.

   a) If the maximum reduction for microfilm is 1% of the original size, what would be the microfilm area of a 7" x 10" page in a textbook?

   b) If the size of the original is 8" x 10", what is the maximum area of the reproduction using a desk projector?

   c) In a regional library, the fiction book section is to be put on microfilm. Currently the dimensions of the wallspace of this corner are 15.6' x 20.3'. When all the books are on microfilm, what wall area will be needed?

8. Still another means of reduction is microfiche (fiche means "index card" in French). Microfiche uses sheet film, either 3" x 5" or 4" x 6". Each records up to 1,000 page images on each card. If 1,000 pages of a text material are reduced to fit on a 4" x 6" microfiche, then what is the area occupied by one page?

ANSWERS:

1. 4.9"

2. 3.28"

3. 4 times

4. 3.2" x 4"

5. .75 ounces acetic acid and 16 ounces water

6. 16.7%

7. (a) .7 sq. in. (b) 120 sq. in. (c) 3.17 sq. fet.

8. .024 sq. in.

SKILL AREAS:

Whole Numbers: division
Powers of Ten: division
Ratio and Proportion
Decimals: multiplication
Percent: finding what percent one number is of another number
finding a percent of a given number
Area: rectangle

Fine Arts and Humanities Cluster

MODEL MAKER

In many design industries a series of steps is required prior to the ultimate construction of a manufactured product or building. One of the initial steps is the draftperson's design of blueprints. This two-dimensional illustration is a precise scale drawing. The next stage, the conversion from the scale drawing to a three-dimensional form is the work of the model maker. The reading of blueprint specifications and construction of scale size or actual size models requires precision, mechanical ability and artistic skill. The model maker's expertise is necessary in the manufacturing of tools, automobiles, aircraft, toys, furniture, etc. Another large employment area of model makers is the field of industrial, commercial or private architecture. Many architects design their own customers' models or employ architectural model makers. Therefore, a person interested in this occupation will find a varied range of employment opportunities.

Certainly to pursue this career, a student would be wise to study high school courses in mathematics. Specific mathematics courses should include geometry, algebra, and practical mathematics. One's studies should include related subjects like mechanical drawing, physics, artistic drawing and drafting.

Post-high school preparation for a position in a manufacturing industry would require a technical program or apprenticeship or on-the-job training experience. Architectural model makers do study college courses in architecture and complete a college degree majoring in architecture.

Seeing what an actual completed manufactured building or topographical site might look like is important. Alterations could be suggested at this stage, thus avoiding unnecessary expenses. Using an endless variety of materials and tools, the model maker completes the creative task.

Activity:

1. Frequently a model maker will be called upon to make a model of a certain portion of land which shows the mountains, hills, valleys and streams. The model will be constructed from the information supplied by a contour map.

   A contour map shows many lines which bend and curve across its surface. Each of these lines is called a contour line and a sufficient number of them enables you to "see" and read the third dimension from the flat map. Just follow a contour line and all the points on this line are the same elevation above sea level. The number of feet above sea

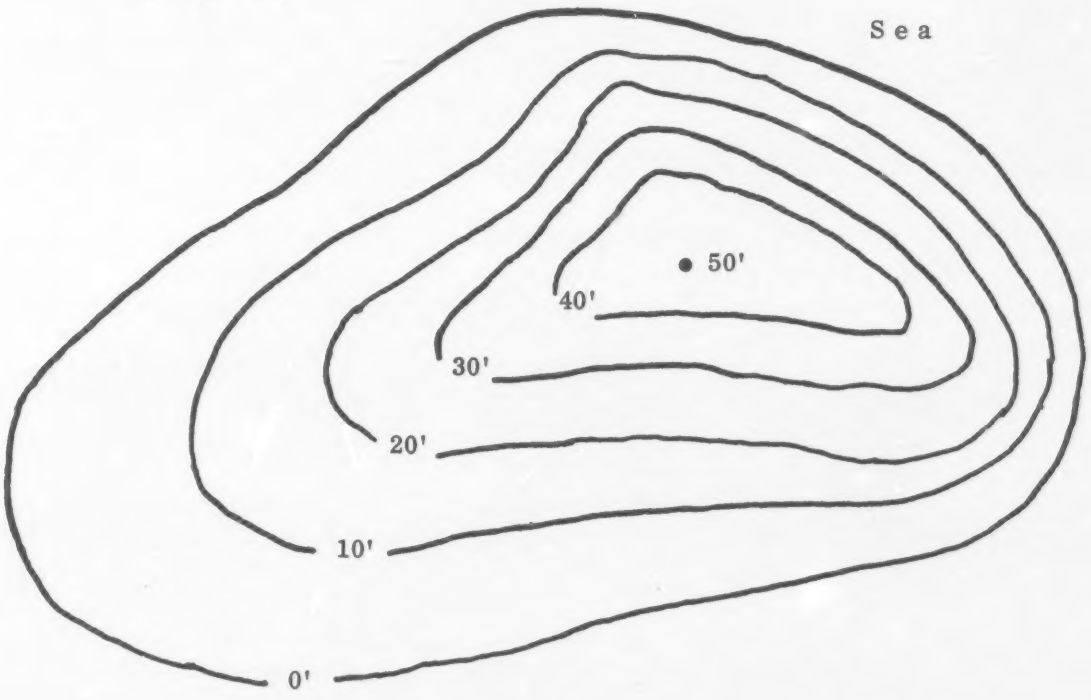
level is the number which appears on the line. Thus, when one line is labeled 10' and another line labeled 30', you know there is a 20' difference in elevation between these lines.

The contour lines also indicate steepness and shape. The closer the lines come together, the steeper the slope is in that region and the farther the lines are apart, the gentler the slope is in that region. The shape is indicated by the direction of the curved lines.

The following activity will give you some idea as to how the model maker can change a flat drawing into a three-dimensional model.

Use the contour map of Cone Island and construct a clay model using the scale of 1" = 10' of elevation

Cone Island
Contour Map



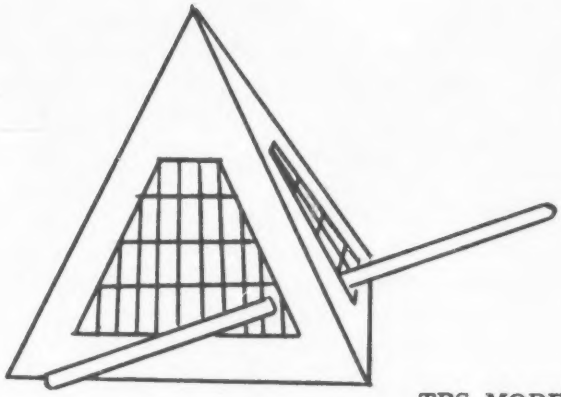
2. As a model-maker, you have been asked by the U.S. Defense Department to construct several different satellite models for use in museums.

a) The smallest of all U.S. satellites is TRS series, also known as the environmental research satellite. The TRS, or tetrahedral research satellite, was designed primarily for research. The first TRS was launched in 1962 to detect radiation effects after an atomic bomb burst high over an island in the Pacific Ocean. Others have been used on secret missions. As its name suggests, the TRS satellites are tetrahedrons with black rectangular solar panels on all sides. Through two of its sides project an antenna. Construct a model of this satellite using cardboard, paper or straws. (See figure).

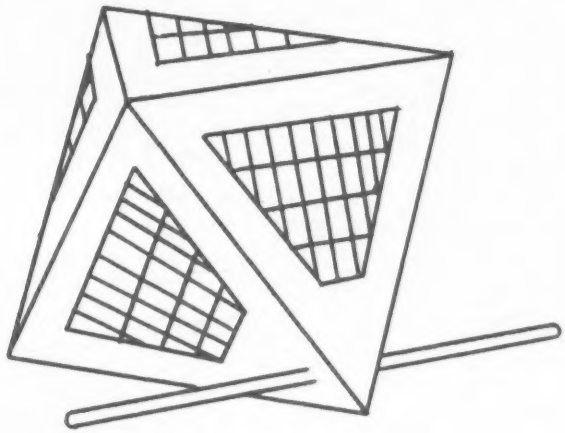
b) The ORS, or octahedral research satellite, is in the same class as the TRS. As its name suggests, the ORS has eight faces. Usually this satellite resembles 2 square pyramids glued together at their bases. Each of the eight faces contains black solar panels. One antenna is found on the satellite jutting out of two opposite sides. Construct an ORS model. (See figure).

c) The OAO, orbiting astronomical observatory, is an octagonal prism measuring ten feet in length. It is designed to carry one thousand pounds of scientific equipment, including a 36" telescope. Use a scale of 1' = 10" and construct this satellite. Since the OAO is built of aluminum, cover your model with foil to make it realistic. (See figure).

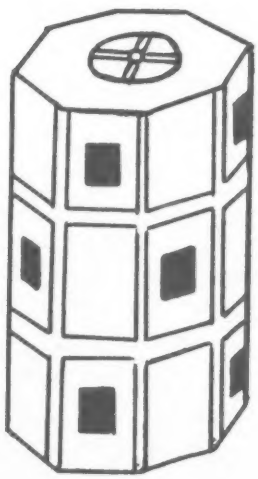
d) Many other models of satellites can be found in a book by Frank Ross entitled Model Satellites and Spacecraft.



TRS MODEL



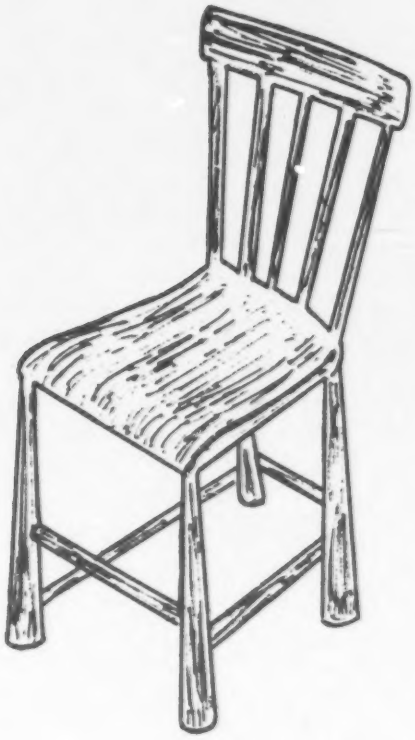
ORS MODEL

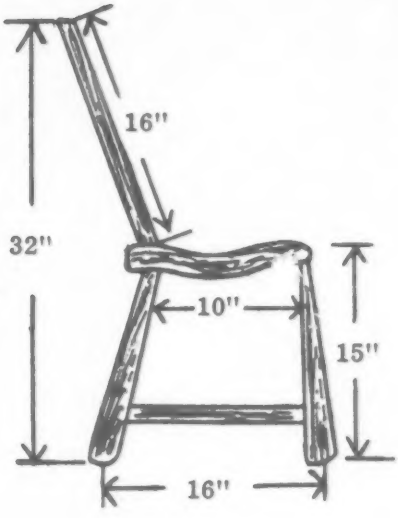


OAO MODEL

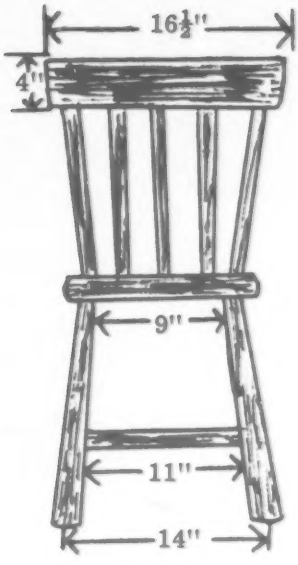
3. Model makers are often employed by toy companies to construct models of new playthings. This is especially true in the manufacture of hobby and craft kits. One large industry is that of doll house furniture including the model kits. Usually the model maker works from blueprints drawn by others. Patterns for a kitchen windsor side chair are given. After closely examining the plans, construct a doll house model as a model maker would. If soft, close grained wood like basswood is not available from craft stores, construct the chair using toothpicks and glue. Dimensions given are actual measurements. Model makers usually use a scale of 1' = 1".

KITCHEN WINDSOR





SIDE VIEW



FRONT VIEW

4. Model makers are sometimes employed by large industries to construct educational materials. You can receive a kit of a model oil refinery from Chevron Oil Company, 1200 State Street, Perth Amboy, N.J. 08861.

ANSWERS:

Will vary.

SKILL AREAS:

Ratio and Proportion

Scale Drawing

Fine Arts and Humanities Cluster

PHOTOGRAPHER

The work of a commercial photographer combines many skills to produce attractive pictures. In this occupation there are two basic areas of specialty: still and motion picture techniques. An individual needs to be familiar with different types of cameras along with such accessories as filters and special lenses. This occupation requires that a person be capable in mathematics so as to interpret shutter speed and focal length.

Many photographers are not only skilled in picture-making, but are experts in developing their own work. A combination of the following qualities are also essential for success in this career: good eyesight, artistic ability, imagination and creativity.

In terms of employment opportunities, the possibilities are numerous. Newspapers, magazines and television stations have photographers on their staffs. Many photographers, however, prefer to free lance and take only choice assignments from different employers. Other individuals look for interesting events or settings to photograph and then try to sell their finished product much as an artist would do.

Training in this occupation ranges from courses of study in high school and college to gaining on-the-job experience. A major prerequisite is a strong interest in this kind of work. In fact, most people who become photographers first begin by taking pictures as a hobby and then join camera clubs, etc. to pursue this interest. Individuals who are interested in this kind of occupation should be aware that there are opportunities but competition is keen. Satisfaction in this occupation is not only financial but also in knowing that one has effectively brought a factual and/or artistic picture of the world to others.

Activity:

The workings of the photographer's equipment is very complex. Every photographer, somewhere in the training or apprenticeship, learned the mathematics of the camera's operation. Carefully read the following explanation which will describe to you how to control the amount of light reaching the film and how to determine the distance from the subject to be photographed.

On a 35 mm lens, stops are marked with numbers prefixed by the letter (f). Photographers call this the "f - stop" or "f - number". These numbers indicate the relationship between the lens opening (photographers call this the aperture) and the focal length (length of the focus) of the lens. The focal length is the distance between the lens and the point at which a distant image will be in sharp focus. A 6-inch lens means a focal length of 6 inches.

This formula is: $\text{f - stop} = \dfrac{\text{focal length of lens}}{\text{diameter of aperture}}$

The 6-inch lens has an aperture diameter of 3 so the f-stop is 2 because

$$2 = \frac{6}{3}$$

Look at a 35 mm camera with typical f - stops. The typical f-stops on a 35 mm camera are the series 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45 and 64.

Important facts about f-stops are:

a) The smallest number represents the widest aperture.
b) Between any two f-numbers in the series, the exposure time is doubled when photographing under the same lighting conditions.

Example:

For 1/50th second exposure at f-stop number 8, 1/25th second exposure is needed for f-stop number 11. Thus the exposure is doubled to allow for the entrance of more light.

1. What is the exposure time for the next f-stop at f/16?

2. What is the exposure time for the next f-stop at f/22?

Flash Photography:

For the photographer to determine the correct aperture (lens opening) for a flash photograph, the photographer takes a given flash number (guide number on flashbulb). Then this simple computation is made:

$$\frac{\text{Guide Number}}{\text{Distance to Subject}} = \text{f-stop (aperture opening)}$$

Example:

The flashbulb guide number is 80. The distance to the subject to be photographed is 10 ft.

$\frac{80}{10} = 8$ The f-stop setting should be 8 for a clear photograph.

Determine the following f-stops or distances from the given figures below:

3. Flashbulb number 40
   Distance from subject 10 ft.
   f-stop number?_____

4. Flashbulb number 80
   Distance from subject 40 ft.
   f-stop number?_____

5. Flashbulb number 80
   Distance from subject?_____
   f-stop number 16

6. Flashbulb number 100
   Distance from subject? _____
   f-stop number 32

Hands-on Activity:

7. Use a 35 mm camera and select a subject to photograph out of doors. Check the f-stops on the camera in order to produce clear photographs given the following conditions:

   a. bright sun
   b. cloudy
   c. heavy overcast
   d. tree shade

ANSWERS:

To the teacher: For this activity a 35 mm camera should be available for the students to examine. You might want to investigate resource students or teachers who are familiar with camera operations.

1. 2/25 second
2. 4/25 second
3. f-stop 4
4. f-stop 2
5. distance from subject - 5 ft.
6. distance from subject - 3.125 ft.
7. will vary

SKILL AREAS:

Whole numbers: multiplication, division

Formula application

HEALTH

CLUSTER

Hospital Administrator
Pharmacist
Psychologist

Health Cluster

HOSPITAL ADMINISTRATOR

Hospitals, rehabilitation and convalescent facilities effectively and efficiently operate with large staffs. The work of these individuals is organized and managed by a hospital administrator. In conjunction with the hospital board, this individual coordinates and plans the activities, programs and policies of the facility. Thorough training in economics and business administration is necessary along with involvement in the medical field. This professional's responsibilities are varied and include: maintaining a dependable staff, determining equipment and facility needs, developing budget policies, insuring general operation.

A Hospital Administrator's major concern is the financial network. Once a budget is established, the Administrator apportions these monies. This essential career requires a unique person with specialized experience in business management and mathematics.

Activity

1. The budget of the hospital for this year has a total revenue of $35,000,000. The Hospital Administrator knows that of this total revenue 96% is from net patient service revenue, 3% is from other operating revenue and 1% is from donations. How much money is supplied by each revenue?

2. If the total operating expenses for the same year are $34,620,000, what is the monthly deficit under which the hospital is operating?

3. Every Hospital Administrator relies upon gifts and donations made to the hospital as a means of supplementing the normal operating budget. The fund raising activities are run by dedicated volunteers on a continual basis. Therefore, the Hospital Administrator always has a fund from which to draw emergency monies.

   Currently the fund has $4,535,275 in the account. The Hospital Administrator has received from the staff the following list of urgently needed new equipment:

Radiology Fluoroscopic Unit	$ 167,000
Lab Coulter Counter for blood counts.	43,000
Searle Analytic Radio-assay Counter System. . . .	30,000
Instrument for platelet counts	27,000
Instrument for coagulation studies	15,000
Scientific microscope	9,000

What will be the balance of the fund if all of this equipment is purchased with fund money?

4. The Hospital Administrator always keeps a careful watch on the staff:

physicians	700
medical staff	12
interns	20
residents	60
fellows	8
professional nurses	550
adult volunteers	75
junior volunteers	25

What percent of the total hospital staff is volunteers?

5. For next year, volunteers need to raise money for additional equipment and improvements. The Hospital Administrator has provided the list of items and their prices:

Improvements mandated by the New Jersey State Department of Health	$ 750,000
Patient monitoring equipment for the Burn Center	60,000
Infant Special Care Facility	50,000
New Renal Dialysis Unit	150,000
Addition to X-Ray, Laboratory & Operating Rooms.	2,200,000
New X-Ray Equipment:	
Gyratome for Tomograms	38,996
Automatic Chestfilmer System	75,000
Fluoroscopy, w/105 mm spot film (2)	318,524
Fluoroscopy System T. V. w/tape (3)	370,050
Upgrading of angiography (2)	104,638
Computerized Axial Tomography	680,000
New Surgery Expansion	500,000
Flexitron Nursery X-Ray System.	13,420
Pediatric Gastroscope	3,800
Gastroduodenal Scope for General Medicine	4,400

How much money must be raised to purchase all the items and make the improvements?

ANSWERS:

1. Net patient service revenue $33,600,000

   Other operating revenue $1,050,000

   Donations $350,000

2. Monthly deficit: $31,666.67

3. Balance: $4,244,275

4. 6.9% Volunteers

5. Amount needed: $5,318,828

SKILL AREAS:

Whole numbers (up to 8 digits): addition, subtraction, division (2 digit divisor)

Percent: finding what percent one number is of another,
finding percent of a number

Health Cluster

PHARMACIST

Accuracy and precision are major concerns in the professional life of a pharmacist. The duties and responsibilities of such a person require logical thinking and knowledge of mathematical principles and formulas. As a result of the great variety and complexity of the medicines and prescriptions which a pharmacist must prepare and dispense to the customer, accurate judgement is essential in this career area.

As with all of the health cluster careers, the pharmacist plays a vital role in meeting community needs. The customer often seeks the additional advice of the pharmacist concerning the dosage or application of a prescription as well as a non-prescription medicine. The community pharmacist is often consulted and valued for the important services which he/she provides.

Hospital and research pharmacy is another aspect of this career area which also requires a background in algebra and trigonometry. These professionals work closely with the medical profession, the government and public health services.

With the growing interest of industry and government concerning public health, the pharmacist's skill will be increasingly important.

Activity

At one time pharmacists actually made the pills which were sold to the customers. Now, however, this is handled by pharmaceutical firms which sell them to the pharmacy. Pharmacists do make capsules.

Here is an example of the ingredients for a single capsule:

Aspirin - 5 grains
Caffeine - $\frac{1}{2}$ grain
Coedeine - $\frac{1}{4}$ grain

1. A customer presents the pharmacist with a prescription for the above capsule. The prescription permits the pharmacist to sell the customer 24 capsules. Determine the amount of grains of each ingredient needed for the 24 capsule prescription.

2. A teenager brings a doctor's prescription for a skin treatment lotion to the pharmacist. The prescription calls for a combination of ingredients to make up part of this prescription:

50% alcohol
3% sulpher
10% zinc oxide
3% glycerin

The doctor has prescribed 8 ounces to be used by this patient.

(a) How many ounces of the solution is composed of alcohol?

(b) How many ounces of the treatment is glycerine?

(c) How many ounces of the treatment is sulpher?

(d) How many ounces of the treatment is zinc oxide?

(e) How many ounces of the treatment is other chemicals?

3. Frequently a pharmacist will receive a prescription which calls for 8 ounces of a 50% alcohol solution.

The pharmacist purchases alcohol solutions from a pharmaceutical house, and these "stock solutions" are 80% alcohol. The pharmacist will need to add distilled water so that the 80% solution will be diluted to 50% concentration.

The question is: how much distilled water does the pharmacist need to add?

This must be calculated very carefully because it must be exact. Knowing that 8 ounces are needed to meet the prescription, the pharmacist begins with something less than 8 ounces of the stock solution and adds distilled water.

To [illegible]he exact amount of distilled water to be added, the following formu[illegible] used:

A = Amount of stock solution used (less than the amount needed)

S = Concentration of stock solution (change the % to a decimal)

P = Concentration needed for prescription (change the % to a decimal)

D = Amount of distilled water to be added in ounces.

Formula: $D = A(S - P) \div P$

Use this formula to solve the following problem, variations on which, a pharmacist deals with daily:

(a) Stock solution is 80% alcohol. The prescription calls for 8 ounces of a 50% solution.

How much distilled water must be added? (Let A = 6 ounces)

(b) After adding the amount calculated above, how much 50% alcohol solution will the pharmacist have?

(c) If the prescription calls for 8 ounces, how much "waste" will there be?

ANSWERS:

1. 120 grains of aspirin
   12 grains of caffeine
   6 grams of codeine

2. (a) 4 ozs. of alcohol
   (b) .24 ozs. of glycerine
   (c) .24 ozs. of sulpher
   (d) .8 oz. of zinc oxide
   (e) 2.72 of other chemicals

3. (a) 3.6 ozs.
   (b) 9.6 ozs.
   (c) 1.6 ozs.

SKILL AREAS:

Whole Numbers: multiplication

Decimals: addition, subtraction, multiplication, division

Fractions: multiplication

Percent: finding a percent of a given number

Formula application

Health Cluster

PSYCHOLOGIST: SCHOOL AND EXPERIMENTAL AREAS

There are a number of different specialized fields in psychology, all of which require an expertise in mathematics. A psychologist is concerned with the study of various aspects of human and/or animal behavior. This kind of work involves experimentation under controlled laboratory conditions. Through the test results of this professional, data can be evaluated and recommendations can be made.

The clinical psychologist is primarily involved with people and their personal problems. This individual uses the evaluations from the experiments in the field of psychology to assist him/her in his/her efforts with patients in finding successful solutions to their dilemmas. Usually after somewhat extensive meetings between patient and psychologist, the patient has gained a greater understanding of himself/herself and is able to more effectively solve his/her problems.

As the name implies, the school psychologist is a highly trained specialist involved in education. A major task in this career area is helping students with personality development and learning difficulties. Testing, as well as interpretation of results, are of major importance. Therefore, this psychologist needs a great deal of training in mathematics and statistics.

Depending upon responsibility and salary, the minimum amount of education for most psychology positions is a four-year undergraduate degree. Because of the competition in the field, advanced studies for masters or doctoral degrees has become mandatory. There are certification requirements for the school psychologist which must be met for employment.

In the following activity, you will work with the area of statistics which is an important part of the psychologist's studies.

Activity

The psychologist uses statistics in the analysis and interpretation of test results. Frequently, one number is desired in order to represent all the given numbers in a set of data. The psychologist might decide to use the range, mean, median or standard deviation to help describe the recorded data.

Given 65, 87, 37, 75, 68 and 88 as test scores, the following measures can be found to describe the set:

(a) The range of a given set of data is the difference between the largest and the smallest numbers in the set. 88 - 37 = 51

(b) The median of the data is the middle number of the set if there are an odd number of data. If there are an even number of data, the median is found by averaging the two "middle numbers".

88, 82, 75, 68, 50, 37

The "middle numbers" are 68 and 75. The average of 68 and 75 is 71.5 because (68 + 75) ÷ 2 = 71.5

(c) The mean of the data is the sum of all the numbers divided by the number of numbers in the set. This is sometimes referred to as the arithmetic average.

$$\frac{88 + 87 + 75 + 68 + 65 + 37}{6} = \frac{420}{6} = 70$$

(d) The standard deviation of a set of numbers is widely used to describe how far from the mean the scores are dispersed. This is further explained in the formula below:

$$SD = \sqrt{\frac{1}{N-1} \cdot \left[X - \frac{Y}{N}\right]}$$

SD = Standard deviation
N = Number of numbers in data
X = The sum of squares of each score
Y = The sum of the scores, then squared

Using the given data set -

Scores	Squares of Scores
88	7744
87	7569
75	5625
68	4624
65	4225
37	1369
420	31156

$$SD = \sqrt{\frac{1}{5}\left[31156 - \frac{(420)^2}{6}\right]}$$

$$= \sqrt{\frac{1}{5}\left(31156 - \frac{176400}{6}\right)}$$

$$= \sqrt{\frac{1}{5}(31156 - 29400)}$$

$$= \sqrt{\frac{1}{5}(1756)}$$

$$\sqrt{351.2}$$

$$= 18.74 \text{ (use of calculator)}$$

A large standard deviation is an indication that some students did much better than others. If this number is small, it means that most students performed at a similar level of achievement or ability.

1. The school psychologist has administered The Stanford Achievement Test to a group of 10 fifth graders. The number correct for the spelling test for the ten students is as follows:

   36, 26, 49, 44, 45, 42, 15, 30, 34, 49

   Pretend you are the school psychologist and need the following information about the data:

   (a) The range of the data

   (b) The mean of the data

   (c) The median of the data

   (d) The standard deviation of the scores

   (Round off to the nearest whole numbers)

2. An experimental psychologist has timed rats in a maze. The results of the test for six rats were:

   2 min., 3.5 min., 5 min., 3 min., 6.5 min., 1 min.

   In order to compare the rats individually, the experimental psychologist must compute the range, mean, median and standard deviation of the times.

   Find each measure carefully.

3. Another facet of a school psychologist's work involves the ages of students. Conduct a survey of 20 students and list their ages. (To the nearest year). Try to vary your sample by choosing other than just classmates.

   As the psychologist, then compute the 4 measures that describe the set of numbers. List the students' names and ages in chart form. Ask your teacher if you are allowed to use a calculator to aid your computations.

ANSWERS:

1. (a) 34

   (b) 37

   (c) 39

   (d) 11

2. Range = 5.5

   Median = 3.25

   Mean = 3.5

   Standard Deviation = 1.8

3. Answers will vary.

SKILL AREAS:

Whole Numbers: addition, subtraction, multiplication, division

Decimals: addition, subtraction, multiplication

Perfect Square Roots

Use of Calculator (Optional)

HOSPITALITY

AND

RECREATION

CLUSTER

Statistician
Tennis Court Manager
Travel Counselor

Hospitality and Recreation Cluster

STATISTICIAN

For a career as a statistician, a person must have ability and training in advanced mathematics as well as interest and curiosity about numbers. The statistician works with applied mathematics every day. This work may include the preparation of surveys and samples as well as design of experiments. The statistician collects and analyzes the data and draws conclusions. Interpretation of this numerical data or facts demands a highly skilled individual.

Statisticians are needed in the areas of market research, quality control, population census, government, entertainment, media, etc. These skilled professionals are often hired as consultants in these fields. A statistician may be involved with analyzing the present or predicting future trends. Often a company will spend great quantities of money on advertising campaigns directed at a predicted buying trend determined by a statistician.

All of our fifteen career clusters employ statisticians. To give you a realistic idea of their work, the following activity provides an opportunity to simulate the tasks of a sports statistician.

Activity

The sports statistician deals exclusively with the present, even though people may read more into her/his data. As an example, if a baseball player has a batting average of .327 for the current season, it might be natural for some fans to think he/she will do as well the following season. The statistician, however, has only represented the present and any conclusion from this information is left to the sports fan.

Problem 1: Baseball

The following types of problems are the kinds that a baseball statistician would be expected to compute. The two basic calculations involved in this activity are batting average and slugging percentage. Below are the two formulas needed to obtain these two type of "stats".

$$\text{Batting Average} = \frac{\text{number of hits}}{\text{number of times at bat}}$$

$$\text{Slugging Percentage} = \frac{(\text{number of singles} \times 1) + (\text{number of doubles} \times 2) + (\text{number of triples} \times 3) + (\text{number of home runs} \times 4)}{\text{number of times at bat}}$$

Now try to compute the batting average and slugging percentage for the following. Remember to round off your answers to the nearest thousandth:

Player	Games Played	Times at Bat	Runs Scored	H (singles)	2B (doubles)	3B (triples)	Home Runs	Runs Batted In	Slugging Percentage	Batting Average
J.M.										
1974	126	427	63	100	13	1	22	69		
1975	156	554	95	161	38	1	34	106		
E.C.										
1974	80	174	24	42	4	2	3	17		
1975	117	348	43	92	17	6	2	43		
T.H.										
1974	96	208	32	50	6	3	4	33		
1975	113	165	24	41	6	0	3	24		

Problem 2: Basketball

With a partner, each person is given 25 foul shots. Depending upon the number of baskets, complete the free throw percentage.

Free Throw Percentage =

$$\frac{\text{number of baskets made}}{\text{number of foul shots taken}}$$

Working in the same capacity as a basketball statistician is the person who is counting the 25 free throws and number of baskets. Please keep a careful record on the "Shot Chart" on this page. Also appreciate how much more difficult this kind of work can be during game play when fans are cheering and there is so much distracting noise.

SHOT CHART

SHOT NUMBER	SUCCESSFUL BASKET — PUT AN (✓)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
TOTAL BASKETS	

FREE THROW PERCENTAGE = _____

(Remember to round off to the nearest tenth of a percent)

Problem 3: Football

Either watch a football game in person or on television. Choose one running back and keep a record of the rushing yardage for the entire game and the number of times that player carries the football. Remember to subtract the losses as well as add the gains so that your final total will be accurate. Then compute the game rushing average to the nearest tenth of a yard. Below is the formula and chart you will need to find your result.

$$\text{Game Rushing Average} = \frac{\text{Total number of running yards gained during the game}}{\text{Total number of carries a game}}$$

PLAYER_____

CARRY	NUMBER OF YARDS GAINED	NUMBER OF YARDS LOSS	COMPLETE TOTAL
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

ANSWERS:

Problem 1 - Baseball

	Slugging Percentage	Batting Average
Player J.M.		
1974	.508	.318
1975	.679	.422
Player E.C.		
1974	.391	.293
1975	.437	.336
Player T.H.		
1974	.399	.303
1975	.394	.303

Problem 2 - Basketball

Answers will vary

Problem 3 - Football

Answers will vary

SKILL AREAS:

Whole Numbers: addition, multiplication, division

Integers: addition, subtraction, division

Percent: finding percents

Hospitality and Recreation Cluster

TENNIS COURT MANAGER

There are many individuals, with personal interest in recreational activities, that select careers combining business and pleasure. Indoor/outdoor tennis managers are such persons. The managers oversee the activities when the public or club members are using the tennis facilities. They schedule the court usage time per hour, handle court reservations, collect rental fees, etc. Because of the surging public interest in recreational tennis, more and more facilities are being built all over the country. Good management skills are appreciated by the public. This efficiency is reflected in the organized and pleasant atmosphere of the tennis club or facility. The manager often has invested money in the club and therefore is a partner in the corporation. When new facilities are being designed, contractors work with the manager/owners to determine the desired size to accommodate the needs of the community.

Certainly knowledge and interest in the sport of tennis is important. A good high school background is necessary with a wide variety of courses especially in basic mathematics and business. Because the tennis manager works with the public, a personable individual would have the most success. Some tennis facility managers do take additional business courses after completing high school. This is often the case when the manager also is responsible for the operation of a tennis equipment shop within the club itself.

All in all this career is a promising one for individuals with an interest in the sport and good sound management skill.

Activity

1. As an avid tennis player yourself, you have decided to become one of the partners in an indoor tennis club in your community. You have agreed to manage the club 8 hours per day. As manager, you meet with the architect and builder. They need to know the approximate size of the 6 playing tennis courts to be constructed. Using the diagram of the regulation size court on page 106, allowing for 8' between each court, compute the minimum length and width necessary for the surface area that must be constructed within the club for the total number of courts desired. These dimensions are only the actual playing surface not the lounge, offices, pro shop, sauna and locker rooms which are part of your club.

2. Once the facility is constructed (Ace Tennis Courts) you have the responsibility of computing membership costs, rental fees and hourly playing rates. The following problems will give you experience with this aspect of the tennis court manager's work.

ACT TENNIS COURTS
RATE SCHEDULE

30 Week Season
October 1 through April 28

Court Fees (per hour):

Monday through Friday $320.00
(9:00 a.m. to 5:00 p.m.)

Monday through Friday . . . . . $410.00 (prime time)
(5:00 p.m. to 11:00 p.m.)

Saturday or Sunday . . . . . $410.00 (prime time)

Early Birds (6:00 a.m. to 9:00 a.m. any day) $300.00

Annual membership dues per player of $20.00 is payable with the above membership court costs.

Hourly rental rates per court:
Non-Members:

Monday to Friday.....$15.00/hour
(9:00 a.m. to 5:00 p.m.)

Monday to Friday.....$17.00/hour
(5:00 p.m. to 11:00 p.m.)

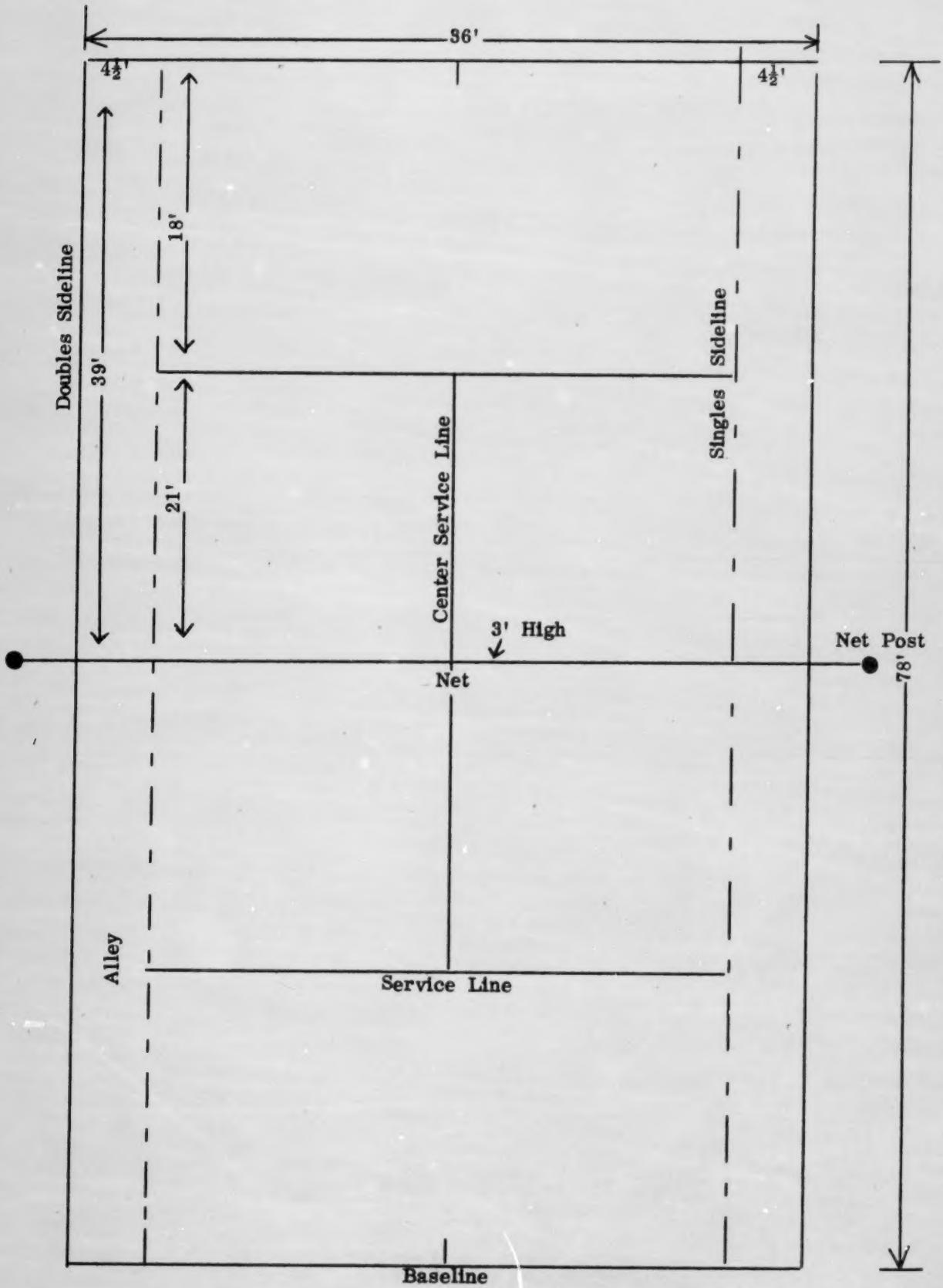
Saturday or Sunday.....$17.00/hour

(a) Four players wish to join your club for the season. They request a court on Monday from 3:00 p.m. to 5:00 p.m. or from 7:00 p.m. to 8:00 p.m. on Friday. They would like to know the rental membership costs for these times. What is the difference between the total costs?

b) Two players wish to rent a court week to week for 1 hour on Saturday morning for the season (October 1 - April 28). Compute the cost for these non-member players. (Use a calendar to determine number of Saturdays). You might want to give them a figure for the same court time for members for them to compare.

c) Two players request a season membership and court reservation and desire 1½ hours playing time. Compute the costs for a Tuesday morning 9:00 a.m. playing time. If they limit their reservation in the evening to one hour rather than 1½ hours, will the evening hour or morning hour-and-a-half be less expensive?

d) A local group wishes to rent your entire facility for a round robin tennis tournament for a Saturday evening from 8:00 to 11:00. They will be playing doubles' teams on all courts. Give the total costs for this group's playing time.


36'
4½'
4½'
Doubles Sideline
39'
18'
21'
Sideline
Singles
Center Service Line
3' High
Net
Net Post
78'
Alley
Service Line
Baseline

ANSWERS:

1. 256' by 78'

2. a) $230

   b) Non-member - 30 x $17 = $510
      Members - $410 + $40 = $450

   c) Tuesdays ($1\frac{1}{2}$) $320 + 40 + 160 = $520

      Wednesdays ($1\frac{1}{2}$) $410 + 40 + 205 = $655

      Wednesdays (1 hr) $410 + 40 = $450

      Wednesday evenings will be less expensive by $70.

   d) 3 x 6 x 17 = $306

SKILL AREAS:

Whole Numbers: multiplication, addition, subtraction

Hospitality and Recreation Cluster

TRAVEL COUNSELOR

Travel counselors are employed by the major United States oil companies as well as travel and motor clubs. These individuals provide a very important public service by planning motor routes for continental travelers and tourists.

Persons in this employment area must have certain minimum qualifications. Major considerations for the careers are previous travel experience, a high school diploma and driver's license. Many companies also administer certain tests to candidates for employment. Eye-Hand coordination is tested since travel counselors work with maps and plot routes. Memory is also evaluated to be certain that counselors can remember basic routes without having to constantly refer to manuals. Map tests are also utilized to insure the person's general knowledge of maps, e.g. latitude, longitude, direction, etc.

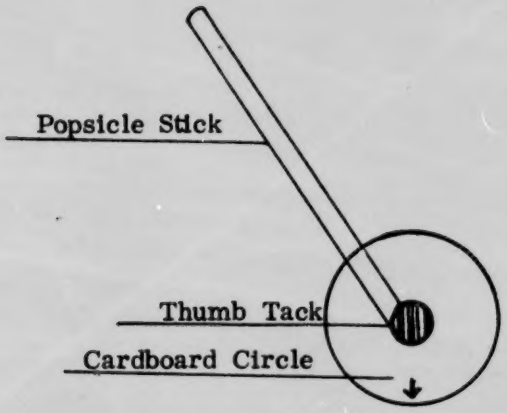
Once a person has been employed, there is an on-the-job training period of three to six months, followed by periodic meetings to discuss route changes as new highways are opened.

People in this employment are not all restricted to a full time schedule. Many individuals work according to the season of the year. There are a greater number of travel counselors for motorists during the summer months.

Individuals who are interested in this occupation area should realize that nothing is cut and dry. The travel counselor is faced with a new challenge by each routing request. As a result, each day can be a new and exciting one as the counselor attempts to meet the particular needs of each person seeking such travel services.

Activity

Before you begin the problems for the travel counselor, consider the following suggestion: Rather than measure your route with a string, construct a trundle wheel. (See diagram on next page).



Instructions:

1" diameter circle cut from cardboard. Draw one arrow on the circle.

1 popsicle stick and a tack to attach the cardboard circle.

Roll the wheel along your route on the map and count the number of revolutions. One revolution of your trundle wheel is about 3 inches. Check your map to determine how many miles are covered by the 3" (one revolution of the wheel). Check with your teacher to be sure of your computation.

To complete the following activity, you need a travel map of the Eastern United States.

Suggestion: Two students working together per map. Use a string or trundle wheel to measure your route.

1. Find the best motor route for a customer wishing to travel from Plainfield, New Jersey to Orlando, Florida, and Disney World.

   The customer would appreciate the most direct route to Disney World in Orlando, Florida. However, the customer has given you a list of tourist attractions which the family desires to visit on the return trip.

   a) Plot the direct route from Plainfield, New Jersey to Orlando, Florida.

      Note: Make sure the route which you have suggested is one which is passable.

b) After a week's stay in Disney World, the customer wishes to visit the list of attractions which follow. Plot the family's return route.

1. Silver Springs, Florida
2. Relatives in Macon, Georgia
3. Myrtle Beach, South Carolina
4. Blowing Rock, Blue Ridge Mountains, North Carolina
5. Natural Bridge, Virginia
6. Williamsburg, Virginia
7. Washington, D.C.
8. Hershey Chocolate, Hershey, Pennsylvania
9. Home, Plainfield, New Jersey

c) What is the total mileage?

2. Find the best motor route for a family being transferred from Boston, Massachusetts to Louisville, Kentucky. Note: This is a one-way trip.

a) Give the customer the route plotted on the map.

b) Give the customer the total mileage he/she can expect to travel.

3. Find the best motor route for a tourist traveling from Scranton, Pennsylvania to Quebec, Canada.

a) Plot the route on the map.

b) Give the customer the total round-trip mileage.

4. In your capacity as a trip counselor, customers often request an estimate of the costs for gasoline.

a) For the family traveling to Disney World, their station wagon gets 20 miles to a gallon of gasoline. At 60¢ per gallon, what is the estimated cost of gasoline for the trip to Disney World?_____

b) For the family being transferred to Louisville, Kentucky, the cost for their gasoline can be determined at 60¢ per gallon in a small van getting 10 miles per gallon. What is the cost? _____

c) The tourist traveling round-trip to Quebec wishes to know the gasoline costs for the sports car which gets 25 miles per gallon at 70¢.

_____

ANSWERS:

Note to the teacher: Answers will vary according to the route selected by the students.

Approximate Answers:

1. a) Plainfield, N.J. to Orlando, Fla. - 1000 to 1200 miles

   b) Return trip will vary

   c) 1000 to 1200 + (return trip mileage computation = total mileage)

2. a) Plotted route will vary.

   b) Boston to Louisville - 900 to 1000 miles

3. a) Plotted route will vary

   b) Scranton to Quebec - 1000 to 1200 miles

4. a) Orlando trip - $30 - $36.00

   b) To Louisville - $54 - $60.00

   c) To Quebec - $28 - $34.00

SKILL AREAS:

Measurement

Whole Numbers: division

Decimals: multiplication

Estimation

MANUFACTURING

CLUSTER

Automotive Design Engineer
Physicist
Sales Manager

Manufacturing Cluster

AUTOMOTIVE DESIGN ENGINEER

A very competitive market exists in the automobile manufacturing industry. Various manufacturers are constantly designing new engines and replacement parts in an effort to create more desirable cars for consumers. Automotive design engineers are responsible for this area of car manufacturing. Through their testing recommendations and data collection, improvements in production can be realized. They then make the information available to the retail car showrooms to be passed on to prospective buyers.

Because the entire market for automobiles depends on maintaining a steady demand for production, the data from the design engineer must be accurate. It is apparent, therefore, that a strong background in engineering and mathematics is necessary for this career in manufacturing.

In the following activity you will examine two charts with the data developed by an automotive design engineer.

Activity

The automotive design engineer has determined a recommended maintenance schedule which is available for the consumer. Examine the following schedule. Complete the requested problems.

RECOMMENDED MAINTENANCE SCHEDULES

Make	Spark Plug Replacement	Oil Change	Oil Filter Change
Chevrolet Vega & Monza Pontiac Astre & Sunbird Oldsmobile Starfire Buick Skyhawk	22,500	7,500	7,500
Datsun (All)	12,500	6,250	6,250
Toyota (All)	12,500	6,500	6,500
Fiat (All)	12,500	6,500	6,500
VW (Rabbit Dasher, Scirocco)	15,000	7,500	15,000
Mazda (Rotary)	12,500	6,250	12,500
Audi (All)	15,000	7,500	15,000
BMW (2002)	12,500	6,500	6,500
Porsche (914)	15,000	5,000	5,000
Triumph (All)	12,500	6,000	6,000
Volvo (All)	15,000	7,500	7,500

1. Over a five year period, the design engineer estimates the average driver travels 60,000 miles. What is the estimated number of spark plug replacements in this time period for a Volkswagen?

2. After testing the Chevrolet Vega, it is estimated that the oil should be changed every 7,500 miles of driving. Estimate the number of oil changes if a car is driven 60,000 miles.

3. After driving 75,000 miles, what is the estimated number of oil filter changes on the Porsche?

4. Determine the number of recommended oil changes and filter changes over 60,000 miles for a Chevrolet and a Triumph.

   a) Chevy _____

   b) Triumph_____

   c) At $.79 per quart with each car requiring 4 quarts for oil changes, what is the total cost of one oil change?

5. a) What is the total cost of oil for 60,000 miles of driving for the Chevrolet? _____ For the Triumph?_____

   b) An oil filter costs $4.50. What is the total cost for oil filters for 60,000 miles of driving for the Chevrolet? _____ For the Triumph? _____

   c) What is the total cost for oil replacement and filters for each car for the 60,000 mile period? _____ Chevrolet? _____ Triumph? _____

Automotive design engineers must give accurate test data and specifications for mileage estimates. This information is passed on from the manufacturing plant to the car distributor. Use the following chart to answer the problems.

SMALL ECONOMY CARS

Make & Model	Engine	Transmission	EPA Estimates	
			Highway	City
Chevrolet Vega Sport Coupe	140-cu.-in. 4 cyl. 2-bbl (barrel)	Manual	35	22
Pontiac-Astre 2-Door Coupe	140-cu.-in. 4 cyl. 2-bbl.	Manual	35	22
Toyota Corona 2-Door Sedan	133.6-cu.-in. 4-cyl. 2-bbl.	Manual	34	20
Datsun 710 2-Door Sedan	119-cu.-in. 4 cyl. 2-bbl.	Manual	33	23
Fiat 131 2-Door Sedan	107-cu.-in. 4 cyl. 2-bbl.	Manual	29	18
Mazda RX-3 Coupe	70-cu.-in. Rotary 4 bbl.	Manual	30	19
VW Dasher 2-Door Sedan	97-cu.-in. 4 cyl. F.I. (fuel injected)	Manual	37	24
Volvo 242 2-Door Sedan	130-cu.-in. 4 cyl. F.I.	Manual	27	17

6. a) Using the Environmental Protection Agency Highway estimates for a Fiat, what is the total highway mileage possible for a 12-gallon gasoline tank?

b) Which car of those listed on the chart has the greatest difference in highway mileage over city driving mileage? _____
What is this difference? _____

c) One of the listed economy cars has traveled 444 miles of highway driving. With a 12-gallon gas tank, what is the average mileage per gallon? _____ Which car has these specifications? _____

ANSWERS:

1. 4 replacements

2. 8 oil changes

3. 15 oil changes

4. a) Chevrolet - 8 oil changes, 8 filters
   b) Triumph - 10 oil changes, 10 filters
   c) $3.16 each oil change

5. a) Chevrolet - $25.28 oil
      Triumph - $31.60 oil
   b) Chevrolet - $36.00 filters
      Triumph - $45.50 filters
   c) Chevrolet - $61.28 total
      Triumph - $77.10 total
      Savings - $15.82

6) a) 348 total miles
   b) Toyota - 14 miles difference
   c) Volkswagen - 37 miles/gal.

SKILL AREAS:

Whole Numbers: division

Decimals: multiplication, subtraction

Manufacturing Cluster

PHYSICIST

Physics is the study and relationship of energy and matter. This requires persons skilled in advanced mathematics and science. In seeking to establish the relationships between energy and matter, the physicist must conduct experiments, analyze data and formulate conclusions. Physicists are continually needed for research and college instruction. One of the largest areas of employment is in manufacturing industries. Electronics, chemical and energy industries are examples of industries that depend on these professionals. It is true that the majority of the physicists' time is spent with experiments in determining scientific interactions and mathematical relationships.

Specialized and technical training and college degrees is necessary for employment as a physicist. In preparation for this career, students should study advanced mathematics, physics and chemistry in their college prepatory program. Research assistants are employed in industry with bachelor degrees. The master's degree and doctorate are necessary for most positions. Therefore, many years pursuing the study of physics is required for employment. An interested individual should recognize that dedication and determination are personal qualities needed in the preparation stages of this career.

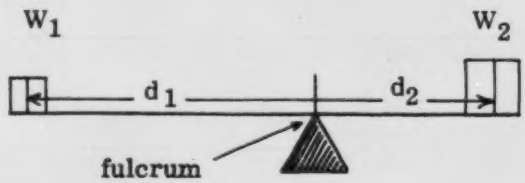
As we seek to further our scientific and technical knowledge of matter and energy and improve products, the need for qualified physicists will increase. There is every reason to believe that the outlook for this career will remain good in the future.

Activity

The duties of a physicist will vary depending upon the company that is the employer. However, the physicist will always be involved with relationships existing between matter and energy. Often a physicist will conduct experiments in order to gather numerical data to determine the existence of a mathematical relationship. By doing the following experiments, you will be simulating some of the work of a physicist.

1. Lever

The following diagram shows one of the simplest forms of the lever (first order lever).



As you see, it resembles a seesaw where the fulcrum is the balance point. This experiment will guide you in discovering a relationship between the weights W_1 and W_2 and the distances d_1 and d_2. Your teacher will supply you with the weights, meter stick and fulcrum for this experiment.

Procedure

1. Set the fulcrum at the "balance point" of the meter stick.
   Note: The "balance point" will never be exactly obtained - you will have to estimate. Also, the d_1 and d_2 in the following table should be measured in centimeters from the "balance point".

2. Complete the table below by finding the "balance point" and recording the distance (d_2) from the fulcrum.

3. Record weights in grams and distances in centimeters.

4. Work in groups of two for the best results.

W_1	d_1	W_2	d_2	$W_1 \cdot d_1$	$W_2 \cdot d_2$
20	40	100			
100	20	50			
50	30	100			
10	30	20			
200	10	50			
500	20	100			

Analysis and Follow-Up:

1. If your work is accurate you should find that $W_1 \cdot d_1 \doteq$ (approx. equal to) $W_2 \cdot d_2$. In an "ideal" situation, it is true that $W_1 \cdot d_1 = W_2 \cdot d_2$. Use this formula to predict where a 200 gm. weight must be placed to balance a 50 gm weight which is 40 cm from the fulcrum. Test your results on the lever.

2. Your results shoud be $W_1 \cdot d_1 \doteq W_2 \cdot d_2$. List some reasons as to why your results must be approximate.

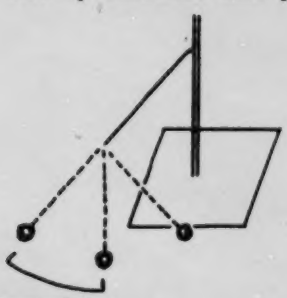
3. Use the formula $W_1 \cdot d_1 = W_2 \cdot d_2$ to solve this interesting problem:

   Find, to the nearest pound, the minimum force necessary to lift a 1500 lb. machine with a pry bar, if the fulcrum is 5" from the machine and 50" from the pushing force. (Draw and label a diagram to aid in this solution).

4. The type of lever you have used in this activity is called a first order lever. Research and write a short report on second and third order levers. Be sure to include what distinguishes one order from another and some uses of each lever.

Pendulum

Your teacher will supply you with the weights, strings and stop watch needed for this experiment. A ring stand with a clamp will be useful but not essential. If possible, a set-up like the one pictured below would be best:



The purpose of this experiment is to show that the displacement of a pendulum does not affect the time (T) for it to swing back and forth once. This time (T) is called the period of the pendulum.

1. Work in groups of two to complete the following table. Note that the displacement is how far from the vertical position you pull the weight; before releasing. Use a metric ruler to obtain a displacement close to the one in the table. Use the <u>first weight column</u> only.

Displacement (cm)	Time (10 Swings)		Time (1 Swing)	
	1st Weight	2nd Weight	1st Weight	2nd Weight
5				
10				
15				
20				

2. Did you find that your values for T (1 swing) are nearly the same? Do you feel that the size of the displacement effects the period?

3. Now replace the weight by a heavier one, but keep the length of the string the <u>same</u> as before. Complete the table for #1 using the 2nd weight columns.

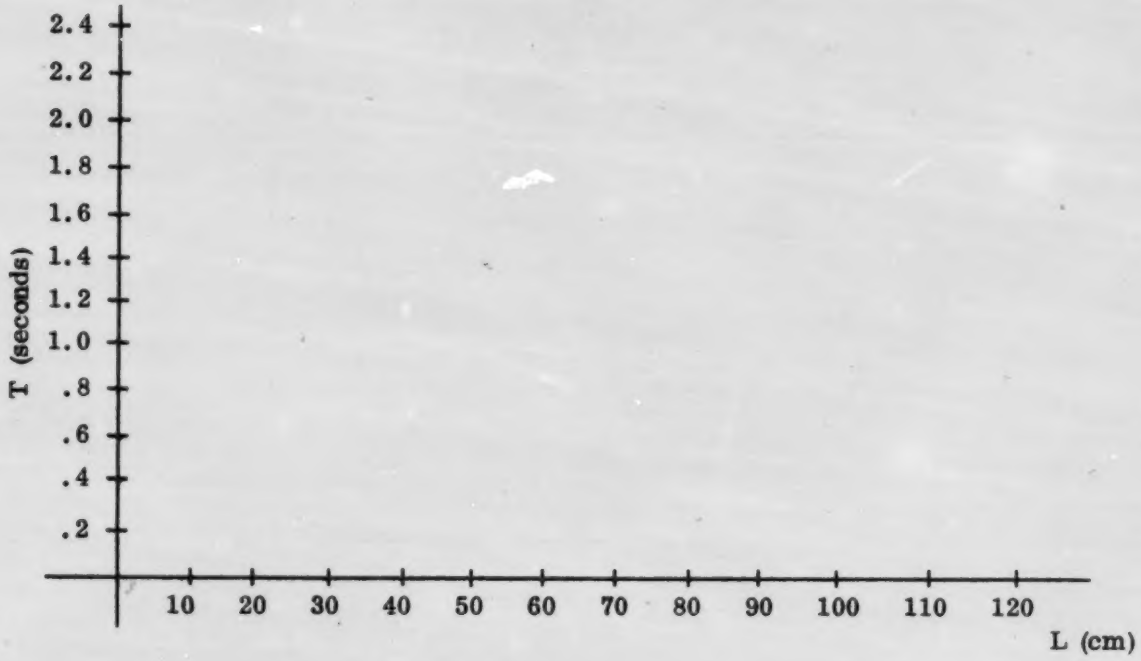
   a) How does the period for the 1st weight compare with the period for the 2nd weight for each displacement?

   b) Does the weight have an effect on the period?

4. The purpose of this part of the experiment is to determine a relationship between the length of the string (L) and the period (T). Use whatever weight you now have on the string. Complete this table:

L (cm)	Time (10 Swings)	Time (1 Swing
10		
20		
40		
80		
100		
120		

5. a) Plot the values for L and T (Period) on the graph below:



b) Do the points appear to be in a straight line?

c) Connect the points with a smooth curve. Read the following information:

1. Approximately how long (L) will the string need to be for a period of 1.0 seconds?

2. If the length of the string is 55 cm., approximately what is the period (T)?

6. (Optional) Research and write a report on how the pendulum can be used in keeping time such as in a grandfather/grandmother clock.

ANSWERS:

Lever

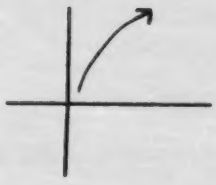
Note: Standard metric weights should be used. Caution the students not to be discouraged if "balance" is not attained. Come Close.

Analysis and Follow-up:

1. 10 cm
2. Will vary
3. 140 lbs. will achieve balance; 141 lbs. would be the minimum force
4. Will vary

Pendulum

1. Table
2. Yes
   No
3. Almost same
   No
4. Table
5. a) General appearance:



   b) No

   c) 1. Approximately 25 cm
      2. Approximately 1.5 sec.

6. (optional) Will vary

SKILL AREAS:

Decimals: division

Graphing

Whole numbers: multiplication, division

Manufacturing Cluster

SALES MANAGER

The sales manager for a manufacturing company is responsible for selling the goods of the firm that employs his/her services. Persons in this occupation need a good background in high school mathematics. Some knowledge of algebra, geometry and statistics is also helpful.

Individuals in this category usually have begun their careers as sales representatives and either have been promoted to management within the same company or sought better positions with other firms. Many businesses have now established a college degree in business administration as a prerequisite for employment as a sales manager.

The sales manager is responsible for all aspects of selling. He/she plans selling campaigns; where to sell a product, how to sell it and how much to charge. Many of these decisions are not entirely his/her own as the sales manager may have to consult the president and/or board of directors of his/her company.

Activity

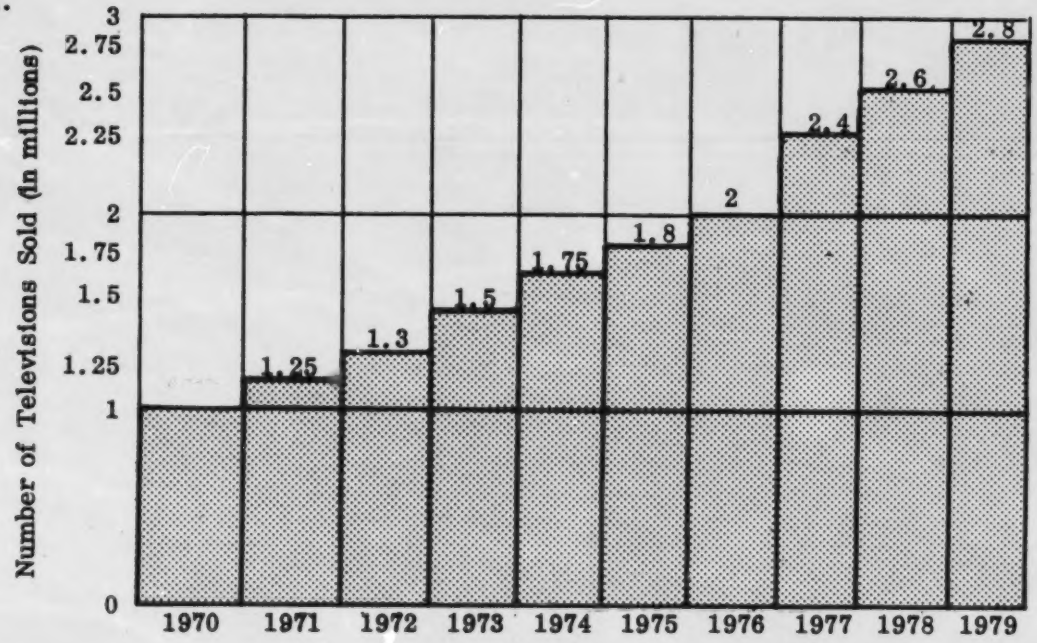
1. Trans-Co. Television Ltd. specializes in the manufacturing of twelve-inch portable televisions. Because this company only manufactures this kind of receiver, it is able to establish a highly competitive discount price. The sales manager of this company is responsible for charting the company sales over the past ten-year period. The figures provided below should be constructed as part of a bar graph so that the data can be easily read and understood by other employees.

YEAR	NUMBER OF TELEVISIONS SOLD (in millions)	COST PER TELEVISION
1970	1	$70.00
1971	1.25	?
1972	1.3	?
1973	1.5	?
1974	1.75	?
1975	1.8	?
1976	2	?
1977	2.4	?
1978	2.6	?
1979	2.9	?

2. The selling price for one television in 1970 was $70.00. Each year this consumer cost has increased by 2.5%. Compute the selling price for the television set for each year and list in table form. Be sure to round off your answers to the nearest penny.

ANSWERS:

1.



2.

Year	Cost per Television
1970	$70.00
1971	71.75
1972	73.54
1973	75.38
1974	77.26
1975	79.19
1976	81.17
1977	83.20
1978	85.28
1979	87.41

SKILL AREAS:

Percent: finding a percent of a given number

Bar Graph: construction

Rounding off

MARINE SCIENCE

CLUSTER

Chemical Oceanographer
Marine Biologist
Physical Oceanographer

Marine Science Cluster

CHEMICAL OCEANOGRAPHER

In a rapidly changing world, the increased need for food and sources of energy has encouraged intensive study of the ocean. The research activities conducted by chemical oceanographers provide the basis for which much of this study is developed. These skilled scientists usually work as a team researching the sea's composition. Their specialized research includes the examination of the chemical make-up of the water and sediment.

As you can see, advanced chemistry, algebra, geometry and calculus courses would be needed for anyone seeking a future in this career. An individual should enjoy research and laboratory procedures. A curious nature and appreciation of the environment are basic characteristics of these scientists.

There is currently an important area of research involving the desalination (salt removal) of the ocean and the effect of temperature on the amount of salt in the water. In the following activities, you will ready a series of charts and graphs which aid the chemical oceanographer in checking the amount of salts and gases dissolved in sea water and measuring the effect of temperature on the amount of salt.

Activity

It is common knowledge that sea water is salty or saline, but the actual amount of salts it contains is quite surprising. (Part B of activity). The number of parts of salts per thousand parts of sea water is a figure known as the salinity of the water. For example, a salinity of 2.5 can mean 2.5 lbs. per thousand lbs. of water or 2.5 grams per thousand grams of water, etc. The chemical oceanographer must know the salinity of the ocean water being studied as this will often be needed in computations. Usually when we think of salt we think of the ordinary table salt (sodium chloride) but the following table shows the presence of many different salts in sea water.

Some Salts of Sea Water	
SALT	Parts per thousand parts of water (Salinity)
Sodium chloride	27.2
Magnesium chloride	3.8
Magnesium sulphate	1.7
Calcium sulphate	1.3
Potassium sulphate	0.9
Calcium carbonate	0.1

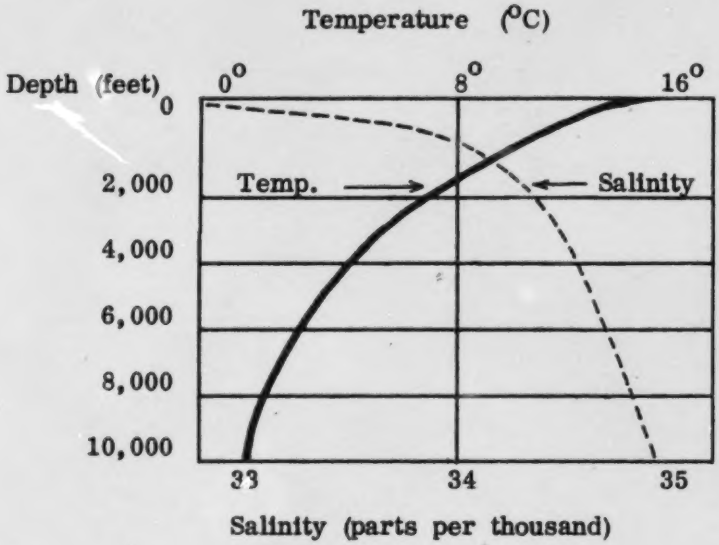
1. Using the previous salt table, answer the following questions:

   a) How much sodium chloride will be present in 100 lbs. of sea water? in 100 grams? in 10 lbs.?

   b) Considering <u>all</u> salts listed above, approximately how many lbs. of <u>all</u> salts will be found in a 1000 lbs. of sea water?

   c) About what percent of the <u>total salts</u> in the ocean is sodium chloride? Calcium sulfate?

2. The previous table on salinity uses figures computed on samples taken near the surface of the ocean. Chemical oceanographers are aware of the fact that salinity and temperature vary as the depth increases. The following graph will illustrate this fact for you. Use the graph to answer the following questions:



   a) Estimate the depth at which the salinity is 34.

   b) At what depth is the temperature 16°?

   c) At what depth is the temperature 4°?

   d) At what depth does maximum salinity occur?

   e) At what depth is the temperature the lowest?

   f) Draw a conclusion about the change in salinity as you leave the surface and increase depth.

3. The chemical oceanographer is also concerned with the gases dissolved in oceanic waters: nitrogen, oxygen and carbon dioxide. Nitrogen is important to certain sea bacteria that use the gas in the production of nitrates, which are essential to life. Oxygen gas is absorbed by marine organisms during respiration and is as vital to them as the water. Carbon dioxide plays a prominent role in the food manufacturing process of photosynthesis. These same gases are also found in the earth's atmosphere but in differing amounts. The chart below compares these 3 gases in air and water:

Gas	% in Air	% in Ocean
Nitrogen	78%	64%
Oxygen	21%	34%
Carbon Dioxide	.03%	1.6%
Other gases	?	?

a) How much more nitrogen is dissolved in air than in the ocean?

b) How much more oxygen is dissolved in the ocean than in the air? How much more carbon dioxide?

c) The proportion of carbon dioxide in the ocean is about ___?___ times greater than in the earth's atmosphere.

d) Using the chart above, what is the percent of other gases dissolved in the ocean?

ANSWERS:

1. a) 2.72 lbs., 2.72 grams, .272 lbs.
   b) 35 lbs.
   c) 77.7%, 3.7%

2. a) 500'
   b) surface
   c) 4000'
   d) 10,000'
   e) 10,000'
   f) increases

3. a) 14%
   b) 13%, 1.57%
   c) 53.3
   d) .4%

SKILL AREAS:

Whole Numbers: subtraction

Decimals: subtraction, addition, division

Powers of 10: division

Percent: finding percent

Graphs

Marine Science Cluster

MARINE BIOLOGIST/FIELD RESEARCHER

Integrating an interest in environmental conditions specialized science and mathematics, the work of marine biologists and field researchers attracts many individuals. The major concern of the marine biologist is the living organisms in sea water. Research would involve the effects of changing conditions on the sea life and safety of the water itself. Current problems with environmental protection of our water supply are being attracted by these specialized scientist. Field researchers and laboratory chemists and technicians also are conducting water testing to determine if the water is safe according to federal environmental protection standards.

One major area of employment of marine biologists is the federal Environmental Protection Agency (EPA). Marine biologists have served as consultants for the agency in federal attempts to establish rules and regulations for acceptable pollution levels in water. With EPA regulations the marine biologist can test water samples and determine if violations of these regulations are occurring. Bacteria, waste, acidity levels are measured and results calculated and charted by the marine biologist. Both field research and laboratory experimentation are involved in this career area.

Students considering this career area or other related fields in marine science should study high school courses in mathematics and all areas of science. Because of the highly specialized nature of this scientific career, interested persons should be aware that advanced college studies are necessary. Degrees in biology, marine engineering, oceanography and chemistry are possible considerations.

The technical data collected, researched and analyzed by marine biologists and field researchers may help to eliminate our current water pollution problems. Thus, this career area can be both exciting and rewarding for dedicated individuals.

Activity

The marine biologist may be called upon to analyze the water in a river in order to determine how clean the body of water really is. The EPA (Environmental Protection Agency) sets standards that a body of water must meet. These federal standards take into account many factors and vary from pollutant to pollutant. Usually the marine biologist performs tests over a period of 30 consecutive days and averages are used to determine whether or not the standards are met. When the pollutants rise above maximum acceptable levels, the EPA may issue a warning to the industry

which is causing the pollution. If the water is not cleaned up within a specified length of time, legal action is taken to force compliance with the regulations. Such action could result in sizeable fines for the industry.

The following is a list of some of the things that a marine biologist would test for in a water sample. Not all are considered pollutants as such but all are connected with water pollution:

ITEM	DESCRIPTION	NORMAL AMOUNT	MAXIMUM ALLOWABLE
B.O.D.	Biochemical Oxygen Demand	10-15 mg/liter	30 mg/liter
T.S.S.	Total Suspended Solids	10-15 mg/liter	45 mg/liter
O.G.	Oil and Grease	10-15 mg/liter	15 mg/liter
D.O.	Dissolved Oxygen	7 mg/liter (ideal)	5 mg/liter (minimum)
T.D.S.	Total Dissolved Solids	450-550 mg/liter	550 mg/liter
P.h.	Parts Hydrogen	6-9	----

1. Check your metric conversion tables and explain why mg/liter is sometimes referred to as parts per million.

2. The following table shows the analysis of 7 days of samples taken from a certain river from July 10 to July 16. Compute the 7-day averages (round to the nearest 10th) and use the previous information to determine whether or not a warning could be issued for each of the tested items. All numbers represent mg/liter except Ph which you should consider as being without units. For Ph determine if the average is in the desired normal range.

DAY	BOD	TSS	Ph	OG	DO	TDS
July 10	22.4	23.6	5.7	12.0	5.8	475.6
July 11	12.3	14.8	6.3	14.5	7.4	515.3
July 12	10.4	37.3	8.0	18.9	5.7	621.1
July 13	16.7	28.5	7.4	19.8	8.3	498.0
July 14	9.4	19.7	5.9	13.7	7.2	418.4
July 15	9.9	18.8	8.5	15.8	6.8	697.8
July 16	12.6	22.4	6.6	20.4	7.5	510.0

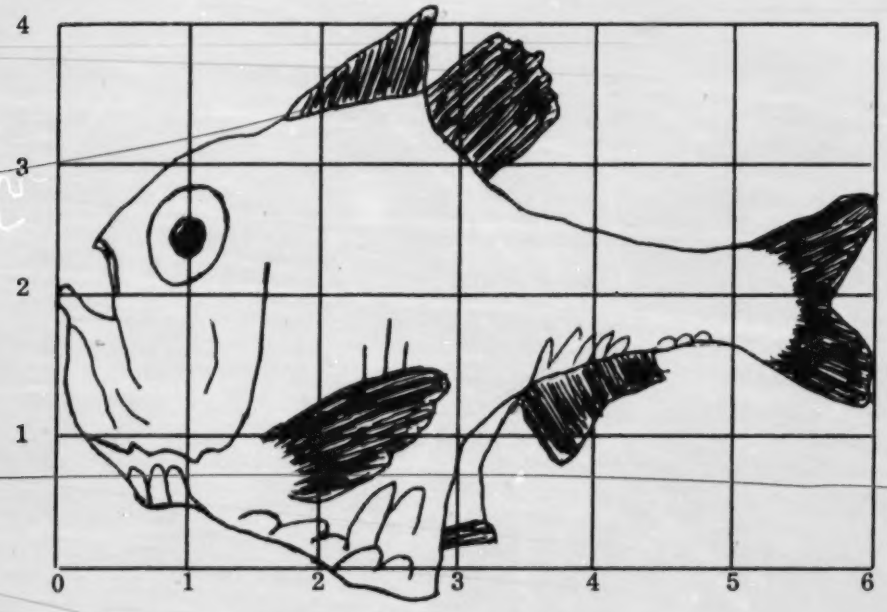
3. A marine biologist must be aware of the great variety of differences existing between fish of the same family or species. Many times two fish will appear to be very dissimilar but will in fact have many similarities in structure which indicates a much closer relationship than the eye would tell.

   The activity which follows involves the use of many varied and unusual coordinates systems. The sample shows a rectangular coordinate system drawn on a fish referred to as Argyropelecus olfersi. If the marine biologist redraws this fish using a different coordinate system (in this case consisting of slanted vertical lines) the resulting sketch very closely resembles a fish known as Sternopytx diaphana. The procedure for obtaining the second sketch from the first involves the transfer of coordinates. For instance, the center of the eye is at the position (1, $2\frac{1}{2}$) in the rectangular system, so this is transferred to the slanted system. The beginning of the tail fin occurs at (5, $2\frac{1}{2}$), (5, 1-3/4) so this is transferred to the slanted system. Using this method, the marine biologist could obtain sketches of fish very similar to fish belonging to a neighboring family.

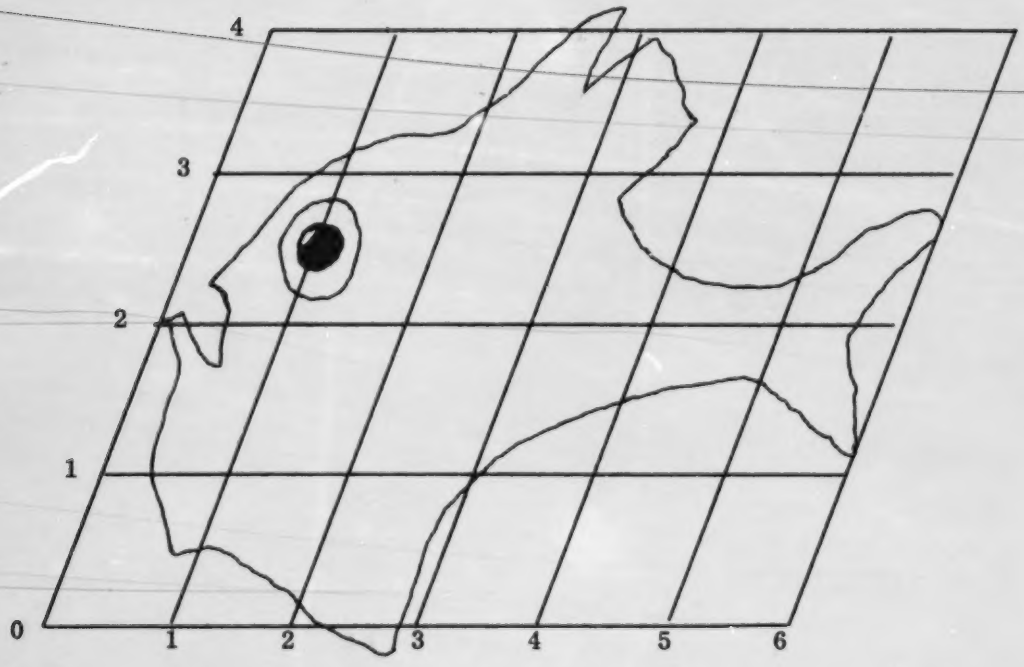
   Complete the sketch already started in the sample. Then use the same method on the remaining problems. Feel free to add some artistic touches after the basic outline is obtained!

   Several studies have been done in a similar manner regarding reptiles such as the crocodile, the rhinoceros and the crab. Evolutionists have used this method of transitional coordinate axes in showing a continuous succession of the growth and development of a particular family. The following examples are taken from a text by D'Arcy Thompson, entitled On Growth and Form, p. 1062-1064.

Sample:

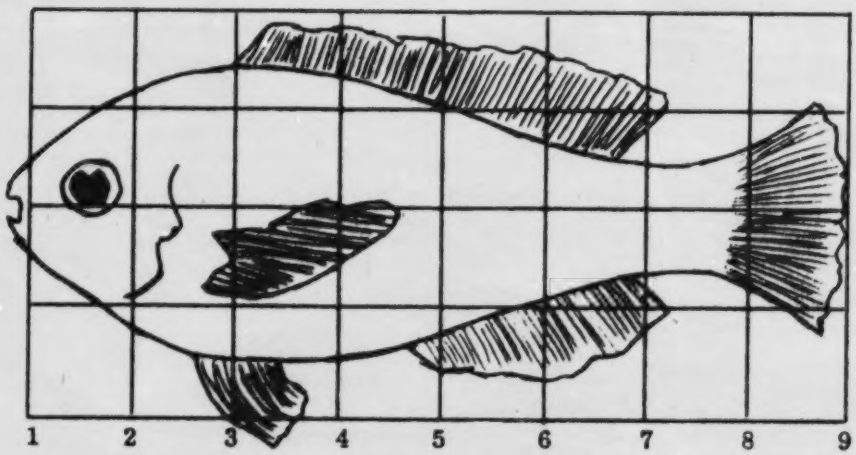


ARGYROPELECUS OLFERSI

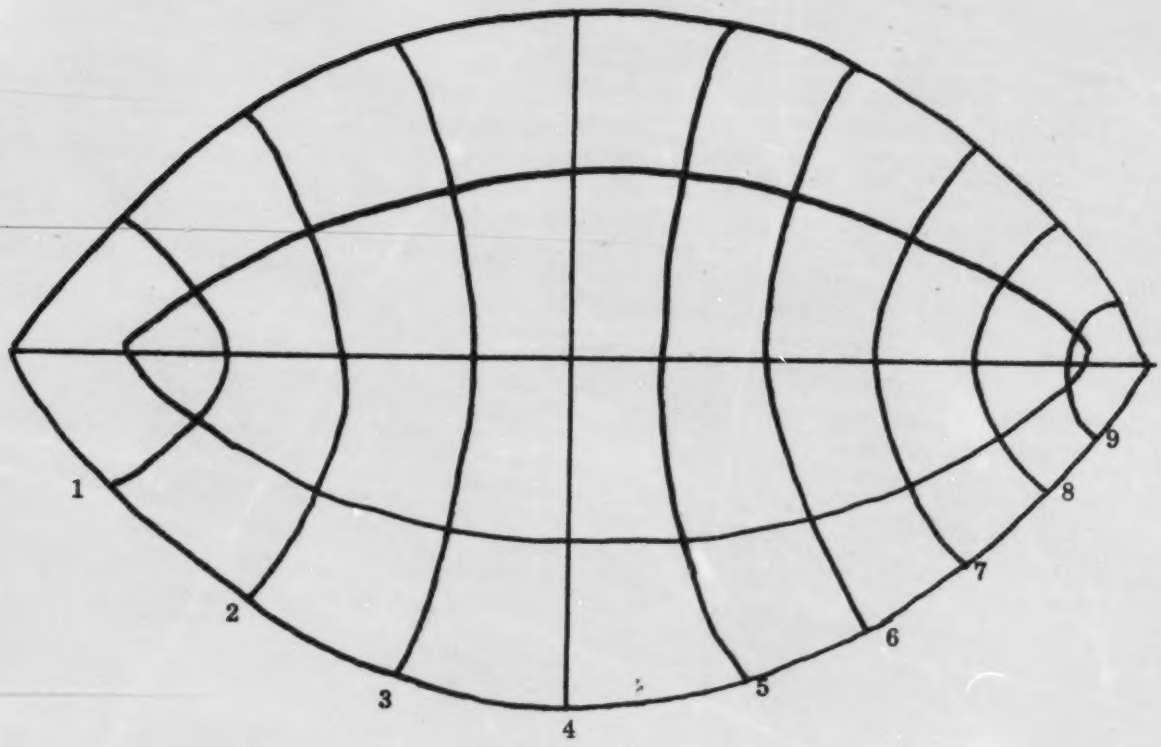


STERNOPTYX DIAPHANA

A.

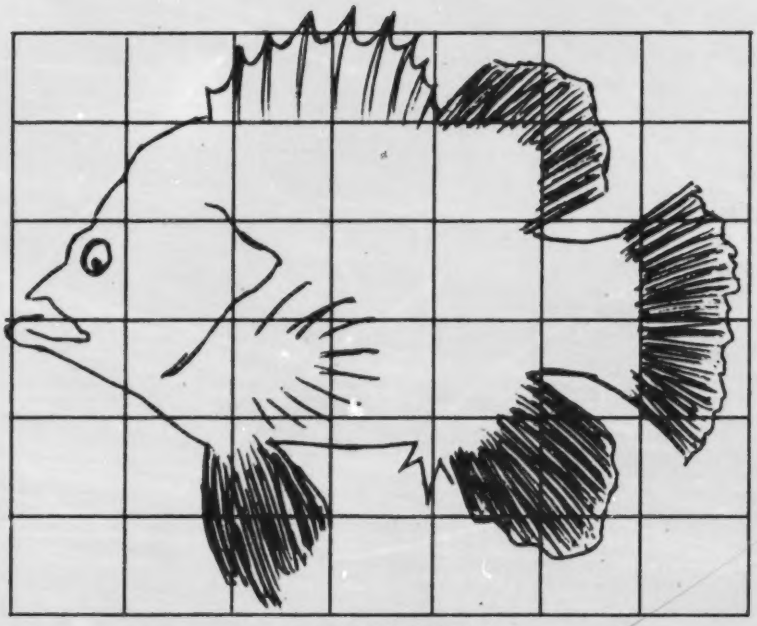


SCARUS

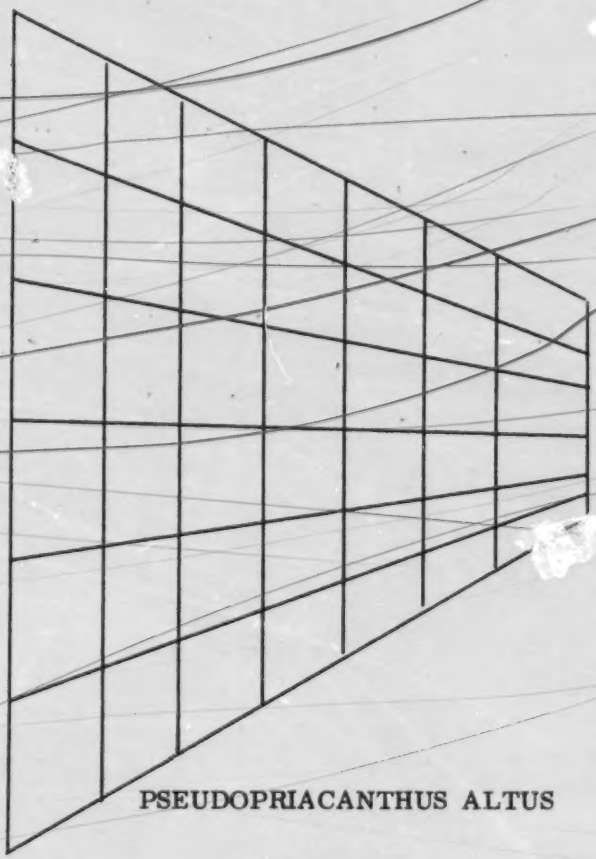


POMACANTHUS

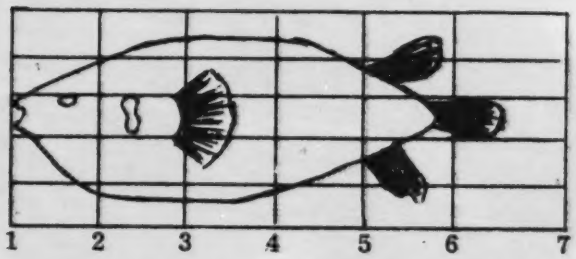
B.



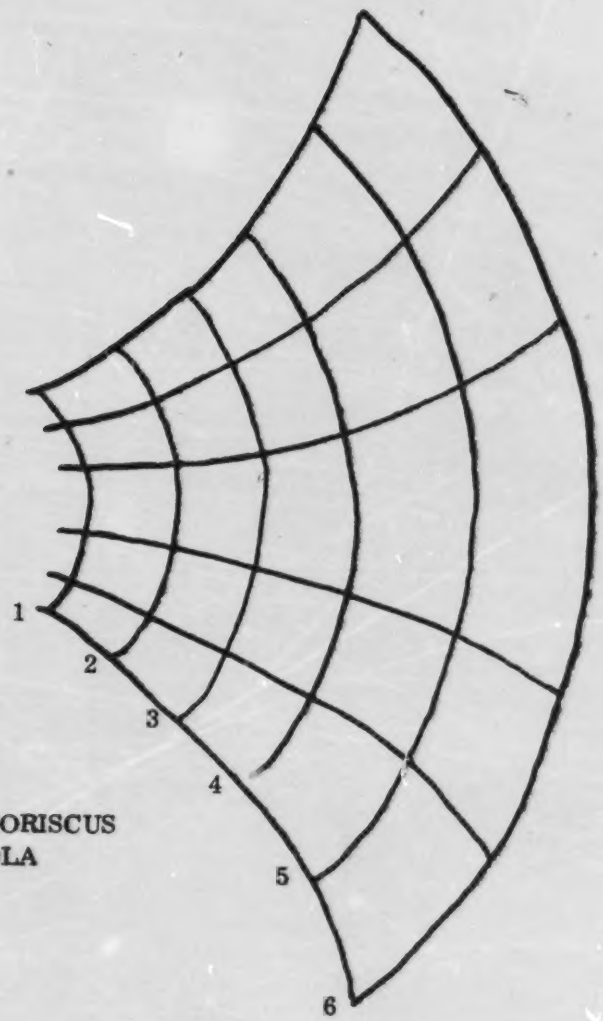
POLYPRION



PSEUDOPRIACANTHUS ALTUS

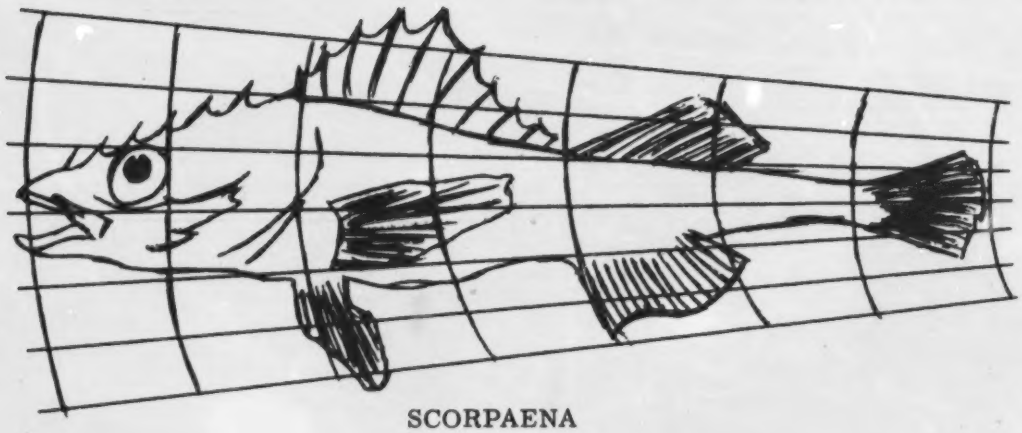


DIODON

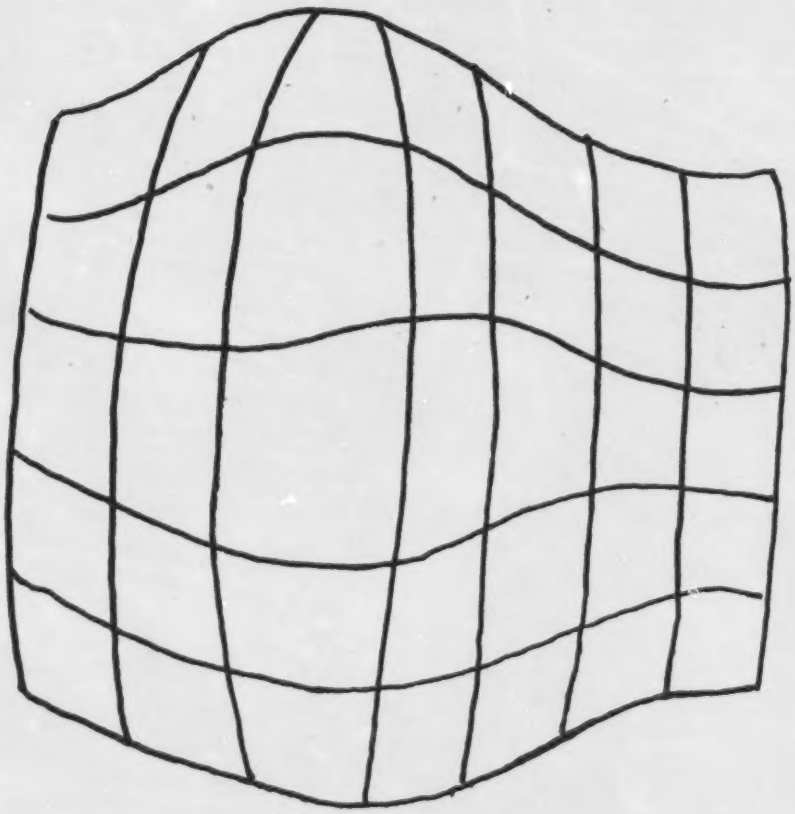


ORTHAGORISCUS
MOLA

D.

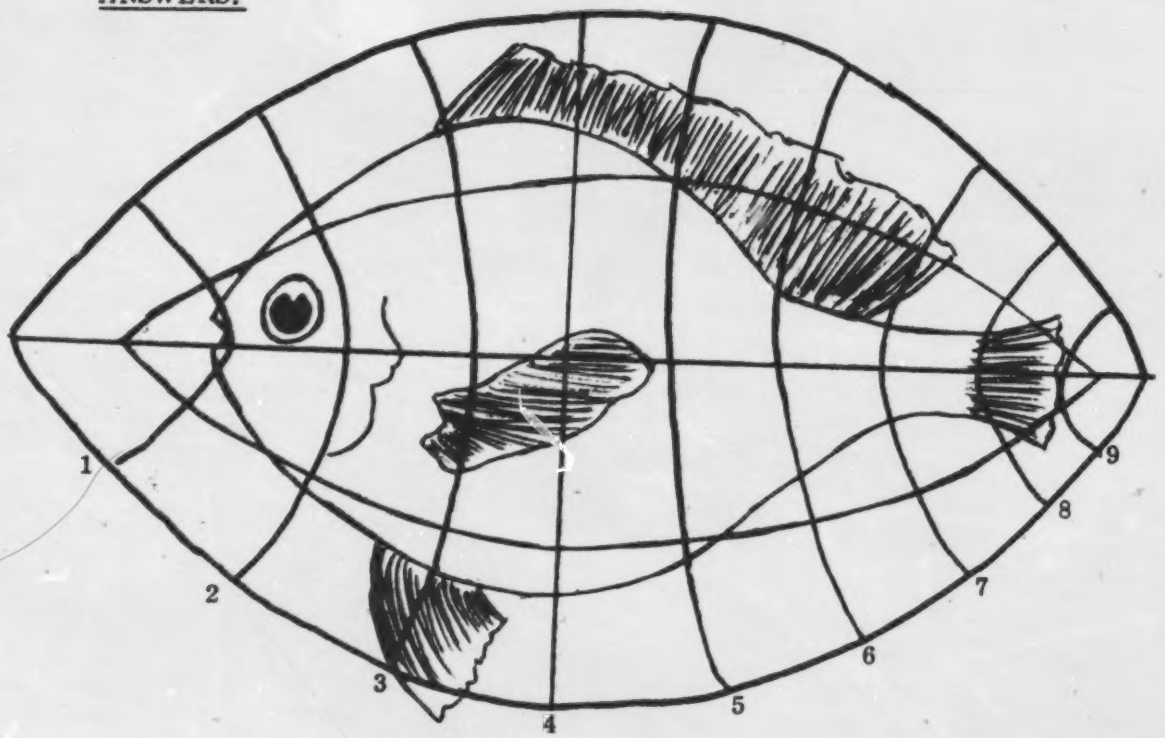


SCORPAENA

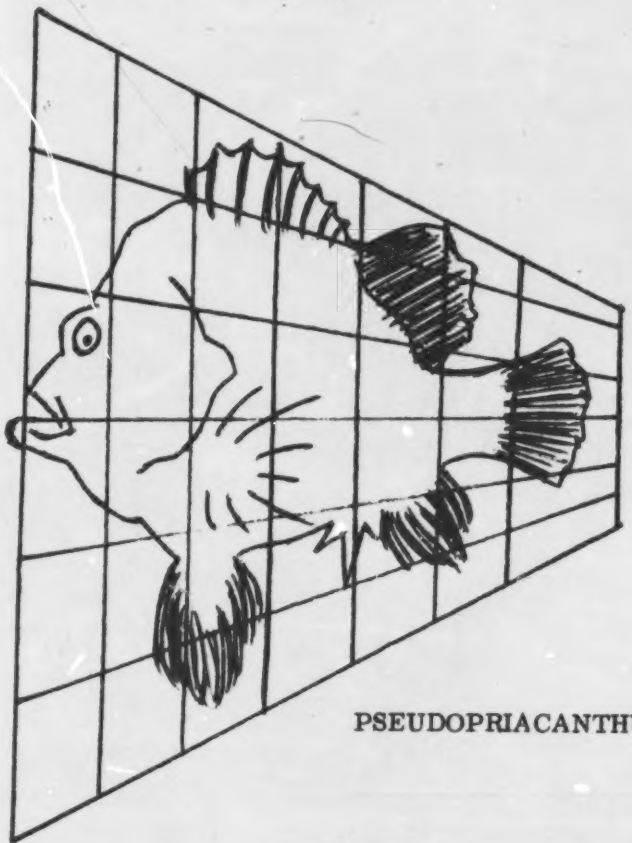


ANTIGONIA CAPROS

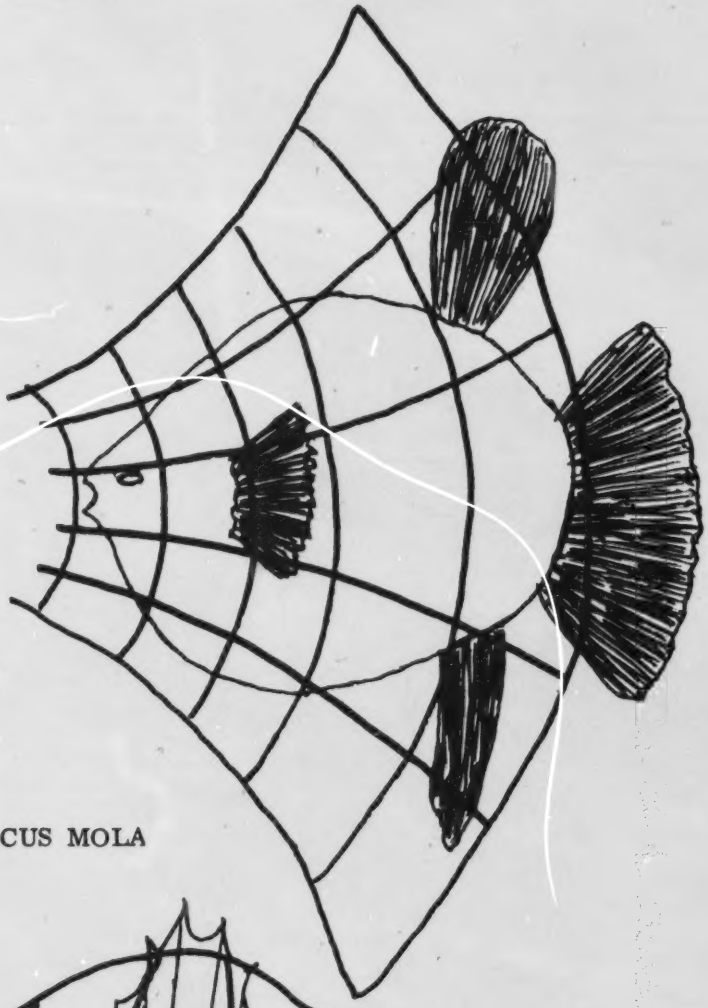
ANSWERS:



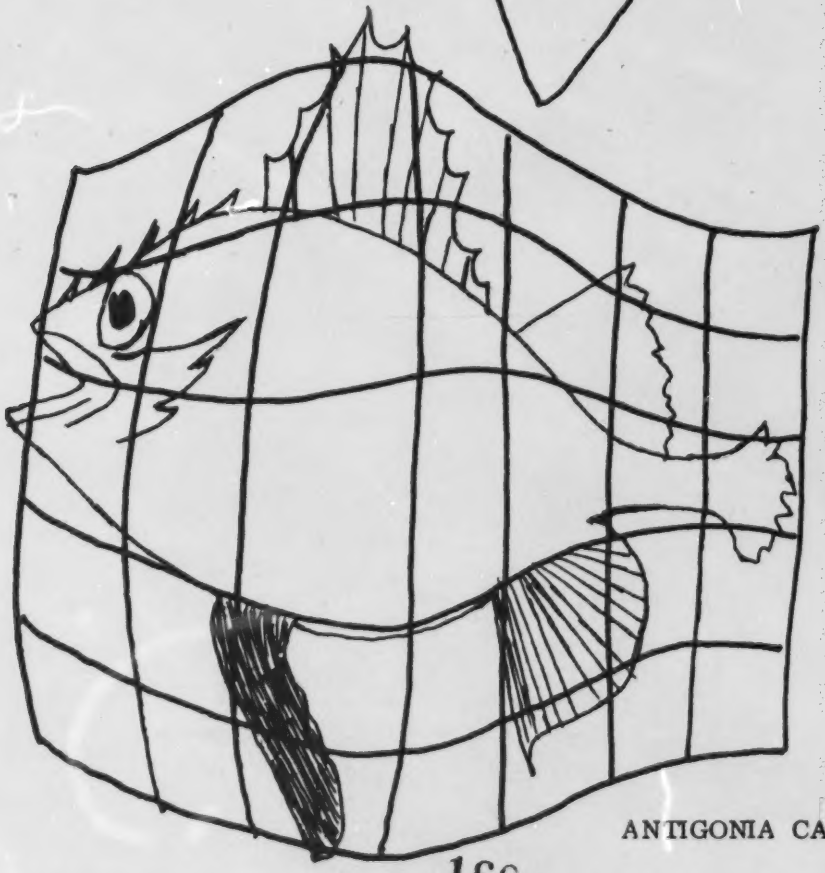
POMACANTHUS



PSEUDOPRIACANTHUS ALTUS



ORTHAGORISCUS MOLA



ANTIGONIA CAPROS

ANSWERS:

1. 1 mg = $\frac{1}{1000}$ g; 1 liter = 1000 g $\therefore$ 1 mg/liter = $\frac{\frac{1}{1000\ g}}{1000\ g} = \frac{1}{1,000,000}$

2. BOD = 13.4 Normal
   TSS = 23.6 Normal
   Ph = 6.9 Normal
   OG = 16.4 Warning issued
   DO = 7 Normal
   TDS = 533.7 Normal

3. See diagrams

SKILL AREAS:

Finding averages

Decimals: addition, division

Marine Science

PHYSICAL OCEANOGRAPHER

Oceans have fascinated people for centuries. For that reason, oceanography has become an important career area involving extensive scientific research. As with most science careers, a thorough background in mathematics is absolutely necessary. A strong interest and ability in algebra, geometry and calculus is recommended.

An important area of oceanographic research is conducted by the physical oceanographer. This professional's background includes a thorough understanding of the sea and its physical properties. He/she studies movements of the sea, tides, and waves. The fishing industry depends on just this information.

Another area of study and research for the physical oceanographer is water temperature. Work is done with a variety of measuring devices. Other ocean characteristics, which these skilled researchers observe and test, include how water can conduct sound and light.

The following activity will involve you in the work of a physical oceanographer.

Activity

1. Almost all oceanographers have some experience in underwater diving. Often diving is a daily adventure. For this reason, the oceanographer must be aware that water pressure is much higher than air pressure and increases with the depth of the water. Normal air pressure is approximately 15 lbs. per square inch while water pressure at 100' down is about 60 lbs. per square inch. Ordinarily, the water pressure on the body of the diver could prevent the person from breathing because the muscles would not be strong enough to expand the chest. To solve this problem, the diver wears a suit that surrounds the body with compressed air. At any specific moment, the air is compressed to the same pressure as that of the water surrounding the diver. Hence, the pressure inside the diver's body is equalized and the squeezing effect is counteracted.

   Water pressure increases by about 4.5 pounds per square inch for every 10 feet below the surface. Hence, at 0', the surface, the pressure is only normal air pressure at about 15 lbs. per square inch. At 10' below the surface, the pressure increases by 4.5 lbs. and is now 19.5 (15 + 4.5) pounds per square inch. At 20' below, the pressure increases again to 24 (19.5 + 4.5) pounds per square inch.

a) In a neat chart, list the water pressures (in lbs. per square inch) for every 500 feet to a depth of 5000 ft. (almost one mile).

b) Then construct a graph from your table. Connect the points plotted.

c) What geometric figure is formed?

d) From your graph, estimate the water pressure at 1700' below the surface.

2. You probably know, from your science class, that sound travels at different speeds through different mediums. The physical oceanographer is primarily interested in the speed of sound in water (about 4800 ft./sec.) This figure helps the oceanographer determine the depth of the ocean. The technique used is called "echo ranging" and involves the use of sonar equipment. The technique is based on a very simple principle which involves the speed of sound in water. Essentially, the sonar device sends a supersonic sound (too high-pitched for human ears) toward the ocean floor. The time it takes for the sound to hit bottom and return is recorded. Since sound travels at the rate of 4800 ft./sec. in water, then the number of seconds elapsed from the sending of the sound to the receiving of that same sound, multiplied by 4800, gives the total number of feet for a round trip. Divide this number by two and you have the depth of the ocean.

Let t = Elapsed time in seconds for supersonic sound to make a round trip. Depth = $\frac{4800.t}{2} = 2400\ t$

a) If a sound is emitted from a sonar device and it takes 3 seconds to return, how deep is the ocean at that point?

b) Suppose it takes $\frac{1}{2}$ second to return?

c) Suppose it takes 1/8 second to return?

3. The same principle can be applied to judging distances across air. A ship at sea which does not carry radar can estimate its distance from an iceberg by sounding the foghorn, directed at an iceberg, and clocking the elapsed time for the sound to return. If sound travels at approximately 1080 ft./sec., write a formula to find the distance to an object, such as an iceberg. Use this formula to find the distance to an iceberg if the sound takes 2 seconds to return.

4. A flash of light from a lightning bolt signals the origin of the sound wave generated by the thunder. Suppose that the sound of thunder is heard 4 seconds after the flash of lightning, how far away is the lightning?

   Try this the next time a thunderstorm occurs in your area. This should, of course, be done from the safety of your house.

5. The physical oceanographer studies the movements of the oceans, including tidal predictions. A simple rule of thumb known as the 1-2-3-3-2-1 rule can help you understand the mathematics of tidal changes. Note that the sum of these figures is 12. This tells you that the water rises by 1/12 of the range in the first hour, by 2/12 (1/6) of the range in the second hour, by 3/12 (1/4) in the third and fourth hour, by 2/12 (1/6) in the fifth and by 1/12 in the sixth hour.

   Suppose that low tide occurs at 9:00 a.m., high tide is at 3:15 p.m., and the height of high water is 9 feet above the low-water level. By the rule of thumb, the water should rise of 1/12 x 9 or 3/4 foot for the first hour between 9:00 a.m. and 10:00 a.m. In the second hour (between 10:00 a.m. and 11:00 a.m.) the water should rise by 2/12 x 9 or 1.5 feet. In the remaining hours the rise of water is done in a similar fashion. To find the height of the water during any particular hour, remember to add the height of the water at low tide.

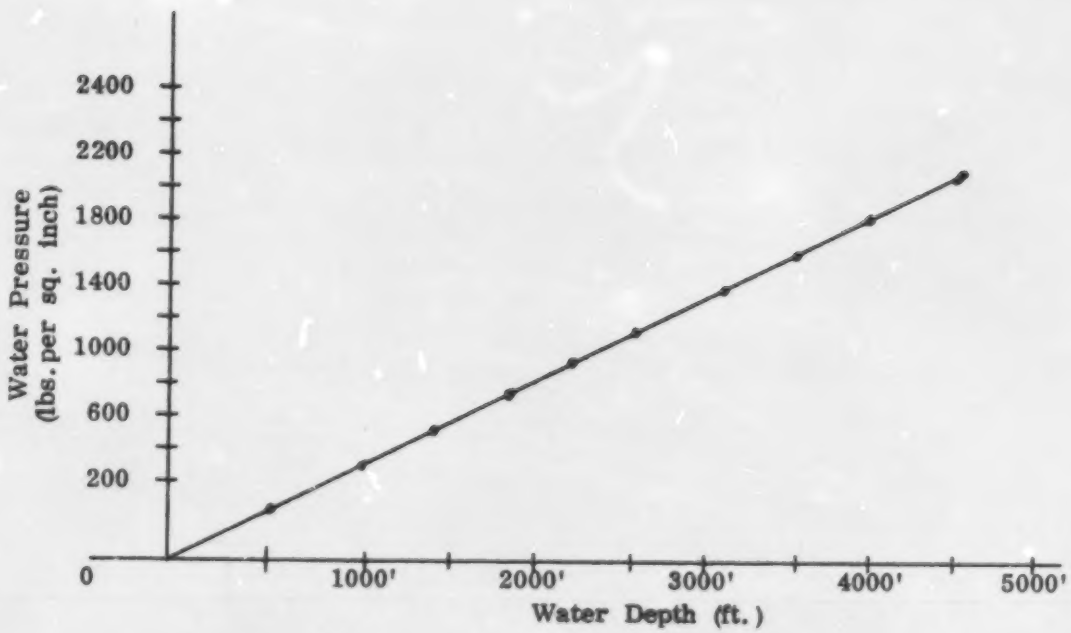
   At Sandy Hook, low tide occurs at 1:00 p.m. and high tide at 7:00 p.m. The height of high water is 15 ft. above the height of low water. Compute the rise in water height for each hour between 1:00 p.m. and 7:00 p.m. Be sure to show your work. Arrange the results in table form.

ANSWERS:

1. a)

Water Depth (in feet)	Water Pressure (in pounds per square inch)
0	15
500	240
1000	465
1500	690
2000	915
2500	1140
3000	1365
3500	1590
4000	1815
4500	2040
5000	2265

b)



c) A straight line is formed

d) at 1700 ft., water pressure is about 780 lbs. per square inch.

2. a) 7200 ft.
   b) 1200 ft.
   c) 300 ft.

3. $D = \frac{1080 \cdot t}{2} = 540 \cdot t$

   1080 ft.

4. 4320 ft. (4 x 1080')

5.

Time	Rise In Water Height
1 PM - 2 PM	1/12 x 15 = 1.25'
2 PM - 3 PM	2/12 x 15 = 2.5'
3 PM - 4 PM	3/12 x 15 = 3.75'
4 PM - 5 PM	3/12 x 15 = 3.75'
5 PM - 6 PM	2/12 x 15 = 2.5'
6 PM - 7 PM	1/12 x 15 = 1.25'

SKILL AREAS:

Whole Numbers: multiplication, division

Fractions: multiplication

Rounding off

Tables and Graphs: construction

MARKETING AND DISTRIBUTION

CLUSTER

Carpet Salesperson
Shipping Clerk
Small Business Owner

Marketing and Distribution Cluster

CARPET SALESPERSON

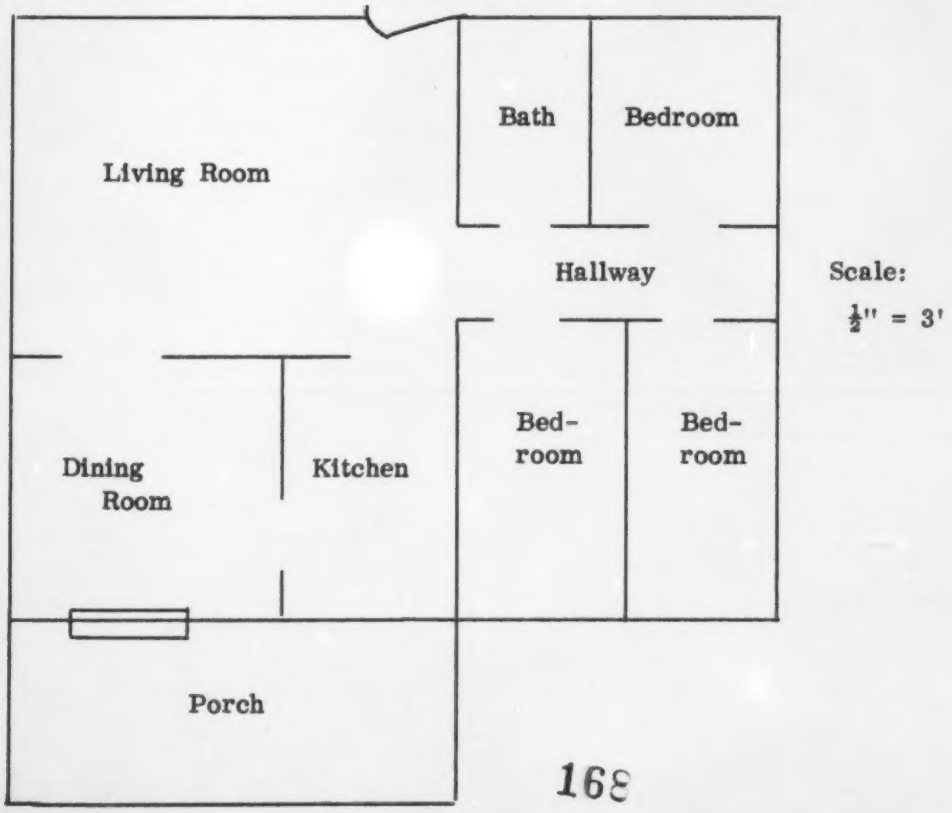
The retail sale of carpeting involves certain numerical skills which are developed in middle school mathematics classes. A successful person in this employment area also needs a good working knowledge in the following:

1. Types, quality and cost of various carpeting
2. Availability of inventory for immediate sale to the consumer.
3. Ability to accurately measure rooms for carpeting so as to insure the least amount of cost for the buyer.
4. Skill in computing the total customer cost of labor as well as materials.

Selling ability and establishing good rapport with the buyer is also important in this occupation. The salesperson should be able to clearly explain his/her measurement computations and overall prices. Likewise, this person must be knowledgeable in the areas of credit arrangements, interest, and time payments, etc.

Activity

A customer needs your advice as a retail carpet salesperson. A scaled floor plan of the house to be carpeted is shown below. With this information you should be able to find the solutions to the following problems.



1. Color-coordinated carpeting has been selected for the three bedrooms at a cost of $12.00 per square yard. The total for this carpeting is $207.00. Find the number of square yards of carpeting needed.

2. The living room, dining room and hallway are to have identical carpeting. The carpeting for which the customer has shown preference retails at $18.00 per square yard including padding and installation. Compute the cost of the purchase of this carpeting. Hint: 9 sq. ft. = 1 sq. yd.

3. The customer has decided to install linoleum tiles in the kitchen. Each tile is one square foot. There are 24 to a box, costing $11.98. How many tiles are needed for the kitchen floor? What is the cost of the tiles? Due to installation charges, the customer decided to self-install the kitchen tiles, thus eliminating labor costs.

4. Compute the total cost of floor covering for this new home. As a courtesy to the customer, your supervisor has granted a 20% discount on this sale. Find the final cost of this purchase. Assess a 5% state sales tax. (Be sure to round off to the nearest penny.)

5. The customer has requested to purchase this floor covering on the store's easy payment plan. This requires the customer to make ten equal time payments at a flat interest charge of 11%. How much will each payment be?

ANSWERS

1. 17.25 sq. yd.
2. $585.00
3. 54 tiles, $35.94
4. $827.94, $695.47
5. $77.20

SKILL AREAS:

Area: rectangles

Decimals: multiplication, addition

Linear Measurement

Percent: finding percent of a given number

Marketing and Distribution Cluster

SHIPPING CLERK

An important part of marketing and distributing of manufactured products is the handling and shipping of these goods to their final destinations. The shipping clerk assumes this responsibility.

A person in this job area might be involved with filling in purchase orders, taking stock inventory and assigning deliveries to independent trucking companies. Ability in mathematics is a necessary skill for success in these duties.

The clerks of a shipping department must examine numbers continually. Since time is an important factor in manufacturing, the shipping clerk must be alert, accurate and quick in his/her work. This task is a most important one when we realize the tremendous number of manufactured goods in the United States and the need for the efficient marketing and distribution of these products.

Activity

Below is a typical invoice. Simulate the role of a shipping clerk by filling in the missing blanks. If you can, check your answers with a calculator. Be sure to round off all answers to the nearest penny.

Purchase Order No. 4279

ACE PLUMBING SUPPLY CO.

Date: 11-17-76
For: Miller Plumbing Phone: 443-2920
Address: 143 Bridge Blvd. City: Gary, Indiana

Quantity	Item	Unit Cost	Cost	Discount	Net Cost
5	3/4" unions	.75	3.75	20%	A
6	3/4" 45° ells	.55	B	30%	C
D	3/4" valves	2.25	9.00	25%	E
12	3/4" x 6" nozzles	F	9.60	G	8.16
5	3/4" faucets	1.75	H	20%	I
J	3/4" 90° ells	.60	K	30%	4.20
L	3/4" fittings	.20	3.60	M	2.34
6	3/4" T-joints	N	P	20%	2.16
				Total	Q
				Less 2% Cash Discount	R
				Net Total	S

ANSWERS:

A = $3.00
B = $3.30
C = $2.31
D = 4
E = $6.75
F = $.80
G = 15%
H = $8.75
I = $7.00
J = 10
K = $6.00
L = 18
M= 35%
N = .45
P = $2.70
Q = $35.92
R = $.72
S = $35.20

SKILL AREAS:

Decimals: multiplication, division (divisor to 2 places)

Percent: 3 cases

Marketing and Distribution Cluster

SMALL BUSINESS OWNER

The small store owner needs to be skilled in many areas. This person must be able to manage all aspects of his/her business regardless of its nature. Ability in selling is, of course, a major requirement. As an employer of perhaps two or three other people, the ability to be a good leader is also essential.

To be a wise and prudent buyer of wholesale items is certainly important. Different manufacturers produce similar kinds of quality tools and it is a shrewd store owner who is able to purchase the best item at the lowest price. Subsequently, these goods now need to be priced for retail sale to customers.

Activity

Below is a sample of a purchase order which includes the type of mathematics used by a hardware store owner. Try to compute the answers and remember to round off to the nearest penny.

Purchase Order No. 36606

CENTER HARDWARE CO.

Date: August 13, 1976

For: Newton High School Phone: 329-4240

Address: 1298 Prairie St. City: Newton, Ill. 62448

Quantity	Description	Unit Cost	Cost	Discount	Net Cost
3	Solder guns, 60 watts	9.75	A	20%	B
12	1 lb. resin solder	C	13.20	30%	D
E	Pkg., resistors	2.35	14.10	F	8.46
2	Pkg., transistors	5.65	G	H	7.91
I	9-volt batteries	.75	J	25%	6.75
3	Staple guns	K	L	10%	32.35
				Total	M
				3% discount if paid within 30 days	N
				6% sales tax	P
				Net Total	Q

ANSWERS:

A = $29.25

B = $23.40

C = $1.10

D = $9.24

E = 6

F = 40%

G = $11.30

H = 30%

I = 12

J = $9.00

K = $11.98

L = $35.94

M = $88.11

N = $85.47

P = $5.13

Q = $90.60

SKILL AREAS:

Decimals: multiplication, division (divisor to 2 places)

Percent: 3 cases

PERSONAL SERVICE

CLUSTER

Chef/Cook
Optician
Tax Accountant

Personal Service Cluster

CHEF/COOK

The food service industry is one of the most rapidly growing employment areas. Included in this category are those individuals who prepare food whenever it is served in hotels, restaurants, schools and colleges, hospitals, industrial cafeterias, private clubs, prisons, retirement homes, on airplanes, ships and railroads.

The preparation and cooking of food has become an art. If a chef's goal is serving an appetizing and nutritional meal, it requires efficient planning, serving estimates and hard work.

Depending upon the size and type of establishment, a cook can be a specialist or have a wide range of jobs. In a large restaurant, many cooks might be employed, each handling one course of the meal, i.e. appetizer, entree, dessert, etc. A small diner would probably employ one cook who might be responsible for all the food preparation as well as service on any counter trade.

Activity

One important qualification for success in this occupation is a working knowledge of basic mathematics. Many times recipes are not written with the measured ingredients for additional desired numbers of servings. If a certain prepared food is listed for four servings, but a cook will need 18 portions, obvious adjustments in measurements will be required. Below is just such a recipe which is measured for only 4 persons. Now, you, as a cook, should re-calculate the ingredients for a party of 18 people.

BEEF STEW

INGREDIENTS FOR FOUR SERVINGS		INGREDIENTS FOR EIGHTEEN SERVINGS	
1-3/4	lbs. beef, 1½ inches thick, chuck or round	A _____	Pounds
1/3	cup flour	B _____	Cups
1/4	teaspoon pepper	C _____	Teaspoons
1/2	teaspoon salt	D _____	Teaspoons
3	tablespoons fat or drippings	E _____	Tablespoons
1/4	cup diced onion	F _____	Cups
1	minced clove of garlic	G _____	Cloves
2-3/4	cups boiling water	H _____	Cups
1	cup canned tomatoes	I _____	Cups
1/2	teaspoon salt	J _____	Teaspoons
1/2	teaspoon Worcestershire Sauce	K _____	Teaspoons
4	medium potatoes, pared, and quartered	L _____	Potatoes
12	small white onions, peeled	M _____	Onions
12	carrots, peeled, cut into 2-inch pieces	N _____	Carrots
1	cup frozen peas (1/2 pkg.)	P _____	Cups

1. Trim excess fat from meat; cut into 1½ inch cubes.
2. Combine flour, pepper, salt in paper bag; add meat; shake until pieces are coated.
3. Melt fat in Dutch oven; add meat; brown on all sides.
4. Add diced onion, garlic, boiling water, canned tomatoes, salt, Worcestershire Sauce.
5. Cover; reduce heat to low; simmer 2 hours or until meat is tender.
6. Add potatoes, onions, carrots; cook 20 minutes.
7. Add peas; cook 15 minutes longer.
8. Serves four.

ANSWERS:

A. 7.875 or 7-7/8

B. 1.5 or $1\frac{1}{2}$

C. 1.125 or 1-1/8

D. 2.25 or $2\frac{1}{4}$

E. 13.5 or $13\frac{1}{2}$

F. 1.125 or 1-1/8

G. 4.5 or $4\frac{1}{2}$

H. 12.375 or 12-3/8

I. 4.5 or $4\frac{1}{2}$

J. 2.25 or $2\frac{1}{4}$

K. 2.25 or $2\frac{1}{4}$

L. 18

M. 54

N. 54

P. 4.5 or $4\frac{1}{2}$

SKILL AREAS:

Decimals: multiplication

Fractions: multiplication

Personal Service Cluster

OPTICIAN

Specialized skills are essential for success in the career of optician. The optometrist is responsible for examining and determining individual vision impairments. Then either the optometrist or the optician, a skilled technician, interprets the prescription and prepares the lenses. The background of these trained professionals includes intensive study of optics, which includes algebra, geometry, calculus and physics.

The optometrist can test the vision of the patient as well as grind lenses and fit glasses. If a problem is evident, the optometrist considers the impairment and suggests corrective measures and/or treatments which are available to the patient.

The optician provides an important role in eye care as well as a vital personal service. His/her work in preparing and fitting the lenses for the patient requires careful examination and accuracy. The optician uses precision tools and instruments in daily activities.

The following activity will involve you in some of the responsibilities of the optician as he/she performs a necessary service.

Activity

An optometrist has just examined your eyes and written a prescription for new glasses. To purchase these glasses, you would consult an optician who grinds the lenses, interprets the prescription, and fits your glasses comfortably.

1. The first job of the optician is to take certain facial measurements for a correct eyeglass frame size:

   a) bridge size - the distance of the bridge of the nose from the inner eye to the other inner eye in a straight line

   b) diameter of the lens size - the diameter of one eye if it were circular

   c) length of the temple - the distance from the temple to the top of the ear

   d) pupillary distance - the distance from one pupil to the other pupil when looking straight ahead

Have a friend take your facial measurements or take your own using a mirror. Be sure to use the metric system and measure to the nearest millimeter. Now take the measurements of three of your friends and arrange the data, including your own measurements, neatly in a chart. At the bottom of the chart, find the averages.

NAME	BRIDGE SIZE	LENS DIAMETER	TEMPLE LENGTH	PUPILLARY DISTANCE
1.				
2.				
3.				
4.				
AVERAGES				

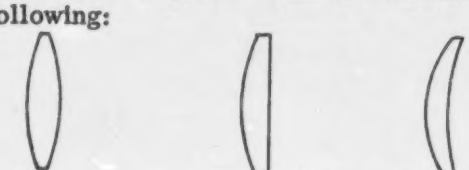
2. After taking your facial measurements, the optician then allows you to try on several eyeglass frames until you select one you prefer. The optician's next task is to grind the lenses to fill your prescription's specific strength. The basic unit of strength for a lens is the diopter. A lens of one diopter has a focus at one meter; a lens of two diopters has a focus at one-half meter or 50 centimeters; a lens of x diopters has a focus at 1/x meter or 1/x x 100 centimeters. For the lenses listed below, find the focal length in centimeters:

   a) a lens of 5 diopters
   b) a lens of 8 diopters
   c) a lens of 2.5 diopters

   For the lenses given below, find the strength in diopters. For example, a focal length of 20 centimeters is 20/100 meter. This reduces to 1/5, so the strength of the lens is 5 diopters.

   d) a focal length of 10 centimeters
   e) a focal length of 25 centimeters
   f) a focal length of 33.3 centimeters

3. The optician must also be aware of the sign (positive or negative) of the strength of the lens. If the diopter is positive, the lens is made for hyperopic (farsighted) eyes and is a convex lens. A hyperopic person has trouble seeing close objects. The convex lens might be similar to one of the following:



Each side of the lens has a different curvature so it has a different strength. In lens C on the preceding page, if the left side is +9 diopters and the right side is +6 diopters, then the lens is said to have a strength of +3 diopters because (+9) - (+6) = +3. Subtraction is used for this convex lens.

If the diopter is negative, the lens is made for myopic (nearsighted) eyes and is a concave lens. A myopic person has difficulty seeing distant objects. The concave lenses might be similar to one of the following:

A B C

In lenc C above, the left side is +6 diopters and the right side is -8 diopters. Since (+6) + (-8) = -2, then the lens has a strength of -2 diopters. Note that addition is used for concave lenses.

An optician has the following lenses. Find the strength for each:

a) Convex lens: left side of +6.50 diopters
right side of +4.25 diopters

b) Concave lens: left side of -3 diopters
right side of -3 diopters

c) Convex lens: left side of +5.37 diopters
right side of +2.87 diopters

4. Your eyeglass prescription might look like the following one. The abbreviation D.V. stands for "distance vision," O.D. means "right eye", and O.S. is "left eye".

		spherical
D.V.	O.D.	+3.25
	O.S.	+3.50

a) What strength lens does the left eye need?
b) Are you nearsighted (myopic) or farsighted (hyperopic)?
c) Are the lenses convex or concave?
d) From what geometric shape will these lenses be cut and ground?
e) The optician has a lens in stock with a left side of +8.75 diopters and a right side of +5.50 diopters. Can this lens be used to fill the prescription? If so, for which eye can it be used?

ANSWERS:

1. Answers will vary

2. a. 20 cm
   b. 12.5 cm
   c. 40 cm
   d. 10 diopters
   e. 4 diopters
   f. 13 diopters

3. a. 2.25 diopters
   b. -6 diopters
   c. 2.50 diopters

4. a. +3.50 diopters
   b. farsighted (hyperopic)
   c. convex
   d. sphere
   e. yes, right eye

SKILL AREAS:

Fractions: reducing, finding reciprocals

Decimals: addition, subtraction

Integers: addition, subtraction

Measurement: conversion meters with centimeters

Personal Service Cluster

TAX ACCOUNTANT

The preparation and examination of federal and state tax returns often requires the specialized training of a tax accountant. Tax procedures vary depending on whether the accountant's responsibilities involve corporate, property or individual income tax. The tax accountant may be in private practice or be employed by the government or a corporation.

Aside from the particular tax specialization, the accountant must be aware of changes in state and federal tax regulations. Very often it is the tax accountant who can suggest methods by which a company or individual can keep regulated payments at a minimum. For accurate and economically sound account analysis, this person must have a background in statistics, accounting, mathematics and data processing.

The preparation of federal and state tax return forms is required of everyone. The following activity will give you an idea of the procedure used by the tax accountant.

Activity - Payment of Federal Income Tax

Who must file? Whether or not you must file a return depends primarily on the amount of your income and your filing status. The form you file must be returned to the Department of the Treasury, Internal Revenue Service. Many individuals employ the services of the tax accountant to complete these federal forms. Because the tax laws frequently change, it is wise to consult these specialists and/or the Internal Revenue Service.

Included in this activity are examples of: a tax table, a tax computation worksheet, tax rate schedules, and a Form 1040A. Remember: new tax tables and tax rate schedules are issued each year by the Internal Revenue Service.

In the following activity you will see some of the procedures used by tax accountants if they are employed to compute federal income tax forms. Keep in mind that for incomes under $15,000 the tax tables must be used while for incomes over $15,000 the tax computation worksheet and tax rate schedules are used. Selection of the correct tax table or schedule depends on the total annual income, the filing status, and the number of exemptions claimed.

Example 1: A single taxpayer has an annual income of $8,425. Read down the income column of Table 1 - Returns Claiming One exemption to the line covering, "at least $8,400 but not over $8,500." Then read across to the column heading covering the correct filing status, in this case Column A (single). The tax shown is $1,128.

Example 2: A single taxpayer has an annual income of $17,000. Because this income is more than $15,000, the Tax Computation Worksheet and Tax Rate Schedules must be used. To compute the taxable income, enter the total income ($17,000) on line 1 of the Tax Computation Worksheet. Enter the amount allowed for filing status (single = $2,300) on line 2. This depends on the box checked on the return. Subtract ($17,000 - $2,300) and put the adjusted amount ($14,700) on line 3. Next multiply the total number of exemptions claimed by $750 and enter the amount on line 4. (In this case the amount will be $750 X 1 = $750) Deduct the amount allowed for exemptions from the adjusted figure ($14,700 - $750) and enter the taxable income ($13,950) on line 5. Now use the appropriate tax rate schedule X, Y, or Z to figure the tax.

Since this taxpayer is single, Schedule X is the correct one to use. Read down the income column to the line covering "income of over $12,000 but not over $14,000," because the taxable income is $13,950. Reading across the line, the tax is $2,630 + 29% of the amount over $12,000. In this instance the amount over $12,000 is $1,950 ($13,950 - $12,000) so the computed tax is $2,630 + ($1,950 X .29) or $2,630 + 565.50 = $3,195.50.

The completed Tax Computation Worksheet for this client is shown on page 161A.

For persons with income under $15,000 using Short Form 1040A.

The standard deduction AND the $750 deduction for each exemption have been allowed in figuring the tax shown in these Tables. Don't take a separate deduction for them if you take your tax from the Tables.

The Tables show the lower tax after taking into account both the percentage standard deduction and the low income allowance except for married persons filing separate returns.

Note for married persons filing separate returns: *The Tables show the tax figured on the percentage standard deduction and on the low income allowance in separate columns. You can take your tax from either column.* **But** *if one uses the percentage standard deduction, then both must use it.*

If you are a married person living apart from your spouse, see paragraph 1(d) on page 4 to see if you can be considered "unmarried" for purposes of using the Tax Tables. If you can, your tax may be lower.

To find your tax—

▶ Select the Table that covers your total number of exemptions on line 7 of your return.

▶ Read down the income columns until you find the line covering the income on line 12 of your return.

▶ Read across to the column heading for your filing status. (If you checked the box on line 5, use the column for "Married filing joint return.")

▶ Enter the tax you find there on line 13a of your return.

Income Averaging.—See note at the top of Tax Rate Schedules X, Y, and Z to see if you can use the "averaging method."

Note: *Be sure to use the figures in the Tax Table columns as follows—*

If you checked the filing status box on—	Find your tax under column
Line 1, Form 1040A	A
Line 4, Form 1040A	B
Line 2 or 5, Form 1040A	C
Line 3, Form 1040A	D

Table 1—Returns claiming ONE exemption (and not itemizing deductions)

If the amount on Form 1040A, line 12, is—		And you are—				If the amount on Form 1040A, line 12, is—		And you are—				If the amount on Form 1040A, line 12, is—		And you are—			
		A. Single, not head of household	B. Head of household	D. Married filing separate return claiming—				A. Single, not head of household	B. Head of household	D. Married filing separate return claiming—				A. Single, not head of household	B. Head of household	D. Married filing separate return claiming—	
At least	But less than			Low income allowance	%Standard deduction	At least	But less than			Low income allowance	%Standard deduction	At least	But less than			Low income allowance	%Standard deduction
		Your tax is—						Your tax is—						Your tax is—			
0	900	0	0	0	0	2,175	2,200	0	0	68	159	3,950	4,000	246	240	362	422
900	925	0	0	0	2	2,200	2,225	0	0	72	162	4,000	4,050	255	248	372	430
925	950	0	0	0	5	2,225	2,250	0	0	76	166	4,050	4,100	263	256	381	438
950	975	0	0	0	8	2,250	2,275	0	0	79	169	4,100	4,150	272	264	391	446
975	1,000	0	0	0	11	2,275	2,300	0	0	83	172	4,150	4,200	280	272	400	454
1,000	1,025	0	0	0	14	2,300	2,325	0	0	87	176	4,200	4,250	289	280	410	462
1,025	1,050	0	0	0	17	2,325	2,350	0	0	91	179	4,250	4,300	297	288	419	470
1,050	1,075	0	0	0	20	2,350	2,375	2	2	94	183	4,300	4,350	306	296	429	478
1,075	1,100	0	0	0	23	2,375	2,400	5	5	98	186	4,350	4,400	315	305	438	486
1,100	1,125	0	0	0	26	2,400	2,425	9	9	102	189	4,400	4,450	324	314	448	494
1,125	1,150	0	0	0	29	2,425	2,450	12	12	106	193	4,450	4,500	334	323	457	502
1,150	1,175	0	0	0	32	2,450	2,475	16	16	109	196	4,500	4,550	343	332	467	510
1,175	1,200	0	0	0	35	2,475	2,500	19	19	113	199	4,550	4,600	353	341	476	518
1,200	1,225	0	0	0	38	2,500	2,525	23	23	117	203	4,600	4,650	362	350	486	526
1,225	1,250	0	0	0	41	2,525	2,550	26	26	121	206	4,650	4,700	372	359	495	534
1,250	1,275	0	0	0	43	2,550	2,575	30	30	124	209	4,700	4,750	381	368	505	542
1,275	1,300	0	0	0	46	2,575	2,600	33	33	128	213	4,750	4,800	391	377	514	550
1,300	1,325	0	0	0	49	2,600	2,625	37	37	132	216	4,800	4,850	400	386	524	558
1,325	1,350	0	0	0	52	2,625	2,650	40	40	136	219	4,850	4,900	410	395	533	565
1,350	1,375	0	0	0	55	2,650	2,675	44	44	139	223	4,900	4,950	419	404	543	574
1,375	1,400	0	0	0	58	2,675	2,700	47	47	143	226	4,950	5,000	429	413	552	582
1,400	1,425	0	0	0	61	2,700	2,725	51	51	147	230	5,000	5,050	438	422	562	589
1,425	1,450	0	0	0	64	2,725	2,750	54	54	151	233	5,050	5,100	448	431	571	597
1,450	1,475	0	0	0	67	2,750	2,775	58	58	155	237	5,100	5,150	457	440	581	605
1,475	1,500	0	0	0	70	2,775	2,800	61	61	159	241	5,150	5,200	467	449	590	613
1,500	1,525	0	0	0	73	2,800	2,825	65	65	163	244	5,200	5,250	476	458	600	621
1,525	1,550	0	0	0	76	2,825	2,850	68	68	167	248	5,250	5,300	486	467	609	629
1,550	1,575	0	0	0	79	2,850	2,875	72	72	171	251	5,300	5,350	495	476	619	637
1,575	1,600	0	0	0	83	2,875	2,900	76	75	175	255	5,350	5,400	505	485	628	645
1,600	1,625	0	0	0	86	2,900	2,925	79	79	179	258	5,400	5,450	514	494	638	653
1,625	1,650	0	0	0	89	2,925	2,950	83	82	183	262	5,450	5,500	524	503	647	661
1,650	1,675	0	0	0	92	2,950	2,975	87	86	187	266	5,500	5,550	533	512	657	669
1,675	1,700	0	0	0	95	2,975	3,000	91	89	191	269	5,550	5,600	543	521	666	677
1,700	1,725	0	0	2	98	3,000	3,050	96	95	197	274	5,600	5,650	552	530	676	685
1,725	1,750	0	0	5	101	3,050	3,100	104	102	205	282	5,650	5,700	562	539	685	694
1,750	1,775	0	0	9	105	3,100	3,150	111	109	213	289	5,700	5,750	571	548	696	703
1,775	1,800	0	0	12	108	3,150	3,200	119	116	221	296	5,750	5,800	581	557	707	712
1,800	1,825	0	0	16	111	3,200	3,250	126	123	229	303	5,800	5,850	590	566	718	721
1,825	1,850	0	0	19	114	3,250	3,300	134	130	238	310	5,850	5,900	600	575	729	731
1,850	1,875	0	0	23	117	3,300	3,350	141	137	246	318	5,900	5,950	609	584	740	740
1,875	1,900	0	0	26	120	3,350	3,400	149	144	255	326	5,950	6,000	619	593	751	749
1,900	1,925	0	0	30	123	3,400	3,450	157	152	263	334	6,000	6,050	628	602	762	758
1,925	1,950	0	0	33	127	3,450	3,500	165	160	272	342	6,050	6,100	638	611	773	768
1,950	1,975	0	0	37	130	3,500	3,550	173	168	280	350	6,100	6,150	647	620	784	777
1,975	2,000	0	0	40	133	3,550	3,600	181	176	289	358	6,150	6,200	657	629	795	786
2,000	2,025	0	0	44	136	3,600	3,650	189	184	297	366	6,200	6,250	666	638	806	795
2,025	2,050	0	0	47	139	3,650	3,700	197	192	306	374	6,250	6,300	676	647	817	805
2,050	2,075	0	0	51	142	3,700	3,750	205	200	315	382	6,300	6,350	685	656	828	814
2,075	2,100	0	0	54	146	3,750	3,800	213	208	324	390	6,350	6,400	695	665	839	823
2,100	2,125	0	0	58	149	3,800	3,850	221	216	334	398	6,400	6,450	706	674	850	832
2,125	2,150	0	0	61	152	3,850	3,900	229	224	343	406						
2,150	2,175	0	0	65	156	3,900	3,950	238	232	353	414						

Continued on next page

Table 1—Returns claiming ONE exemption (and not itemizing deductions) (Continued)

If the amount on Form 1040A, line 12, is— At least	But less than	And you are— A. Single not head of household	B. Head of household	D. Married filing separate return claiming— Low income allowance	D. Married filing separate return claiming— %Standard deduction
		Your tax is—			
6,450	6,500	716	684	861	842
6,500	6,550	727	693	872	851
6,550	6,600	737	703	883	860
6,600	6,650	748	712	894	869
6,650	6,700	758	722	905	879
6,700	6,750	769	731	916	888
6,750	6,800	779	741	927	897
6,800	6,850	790	750	938	906
6,850	6,900	800	760	949	916
6,900	6,950	811	769	960	925
6,950	7,000	821	779	971	934
7,000	7,050	832	788	982	943
7,050	7,100	842	798	993	952
7,100	7,150	853	807	1,004	962
7,150	7,200	863	817	1,015	971
7,200	7,250	874	826	1,026	980
7,250	7,300	884	836	1,037	989
7,300	7,350	895	845	1,048	999
7,350	7,400	905	855	1,059	1,008
7,400	7,450	916	864	1,070	1,017
7,450	7,500	926	874	1,081	1,026
7,500	7,550	937	883	1,092	1,036
7,550	7,600	947	893	1,103	1,045
7,600	7,650	958	902	1,114	1,054
7,650	7,700	968	912	1,125	1,063
7,700	7,750	979	921	1,136	1,073
7,750	7,800	989	931	1,149	1,082
7,800	7,850	1,000	940	1,161	1,091
7,850	7,900	1,010	950	1,174	1,100
7,900	7,950	1,021	959	1,186	1,110
7,950	8,000	1,031	969	1,199	1,119
8,000	8,050	1,042	978	1,211	1,128
8,050	8,100	1,052	988	1,224	1,138
8,100	8,150	1,063	997	1,236	1,149
8,150	8,200	1,073	1,007	1,249	1,161
8,200	8,250	1,084	1,016	1,261	1,174
8,250	8,300	1,094	1,026	1,274	1,186
8,300	8,350	1,105	1,035	1,286	1,199
8,350	8,400	1,116	1,046	1,299	1,211
8,400	8,450	1,128	1,057	1,311	1,224
8,450	8,500	1,140	1,068	1,324	1,236
8,500	8,550	1,152	1,079	1,336	1,249
8,550	8,600	1,164	1,090	1,349	1,261
8,600	8,650	1,176	1,101	1,361	1,274
8,650	8,700	1,188	1,112	1,374	1,286
8,700	8,750	1,200	1,123	1,386	1,299
8,750	8,800	1,212	1,134	1,399	1,311
8,800	8,850	1,224	1,145	1,411	1,324
8,850	8,900	1,236	1,156	1,424	1,336
8,900	8,950	1,248	1,167	1,436	1,349
8,950	9,000	1,260	1,178	1,449	1,361
9,000	9,050	1,272	1,189	1,461	1,374
9,050	9,100	1,284	1,200	1,474	1,386
9,100	9,150	1,296	1,211	1,486	1,399
9,150	9,200	1,308	1,222	1,499	1,411
9,200	9,250	1,320	1,233	1,511	1,424
9,250	9,300	1,332	1,244	1,524	1,436
9,300	9,350	1,344	1,255	1,536	1,449
9,350	9,400	1,356	1,266	1,549	1,461
9,400	9,450	1,368	1,277	1,561	1,474
9,450	9,500	1,380	1,288	1,574	1,486
9,500	9,550	1,392	1,299	1,586	1,499
9,550	9,600	1,404	1,310	1,599	1,511
9,600	9,650	1,416	1,321	1,611	1,524
9,650	9,700	1,428	1,332	1,624	1,536
9,700	9,750	1,440	1,343	1,637	1,549
9,750	9,800	1,452	1,354	1,651	1,561
9,800	9,850	1,464	1,365	1,665	1,574
9,850	9,900	1,476	1,376	1,679	1,586
9,900	9,950	1,488	1,387	1,693	1,599
9,950	10,000	1,500	1,398	1,707	1,611
10,000	10,050	1,511	1,408	1,721	1,624
10,050	10,100	1,521	1,417	1,735	1,637
10,100	10,150	1,531	1,426	1,749	1,651
10,150	10,200	1,541	1,435	1,763	1,665
10,200	10,250	1,551	1,445	1,777	1,679
10,250	10,300	1,561	1,454	1,791	1,693
10,300	10,350	1,572	1,463	1,805	1,707
10,350	10,400	1,582	1,472	1,819	1,721
10,400	10,450	1,592	1,482	1,833	1,735
10,450	10,500	1,602	1,491	1,847	1,749
10,500	10,550	1,613	1,501	1,861	1,763
10,550	10,600	1,623	1,511	1,875	1,777
10,600	10,650	1,634	1,520	1,889	1,791
10,650	10,700	1,644	1,530	1,903	1,805
10,700	10,750	1,655	1,540	1,917	1,819
10,750	10,800	1,665	1,549	1,931	1,833
10,800	10,850	1,676	1,559	1,945	1,847
10,850	10,900	1,686	1,569	1,959	1,861
10,900	10,950	1,697	1,578	1,973	1,875
10,950	11,000	1,707	1,588	1,987	1,889
11,000	11,050	1,718	1,598	2,001	1,903
11,050	11,100	1,728	1,607	2,015	1,917
11,100	11,150	1,739	1,617	2,029	1,931
11,150	11,200	1,749	1,627	2,043	1,945
11,200	11,250	1,760	1,636	2,057	1,959
11,250	11,300	1,770	1,646	2,071	1,973
11,300	11,350	1,781	1,655	2,085	1,987
11,350	11,400	1,791	1,665	2,099	2,001
11,400	11,450	1,802	1,675	2,113	2,015
11,450	11,500	1,812	1,684	2,127	2,029
11,500	11,550	1,823	1,694	2,141	2,043
11,550	11,600	1,833	1,704	2,155	2,057
11,600	11,650	1,844	1,713	2,169	2,071
11,650	11,700	1,854	1,723	2,183	2,085
11,700	11,750	1,865	1,733	2,198	2,099
11,750	11,800	1,875	1,742	2,214	2,113
11,800	11,850	1,886	1,752	2,230	2,127
11,850	11,900	1,896	1,762	2,246	2,141
11,900	11,950	1,907	1,771	2,262	2,155
11,950	12,000	1,917	1,781	2,278	2,169
12,000	12,050	1,928	1,791	2,294	2,183
12,050	12,100	1,938	1,800	2,310	2,198
12,100	12,150	1,949	1,810	2,326	2,214
12,150	12,200	1,959	1,820	2,342	2,230
12,200	12,250	1,970	1,829	2,358	2,246
12,250	12,300	1,980	1,839	2,374	2,262
12,300	12,350	1,991	1,849	2,390	2,278
12,350	12,400	2,001	1,858	2,406	2,294
12,400	12,450	2,012	1,868	2,422	2,310
12,450	12,500	2,022	1,878	2,438	2,326
12,500	12,550	2,033	1,887	2,454	2,342
12,550	12,600	2,043	1,897	2,470	2,358
12,600	12,650	2,054	1,907	2,486	2,374
12,650	12,700	2,064	1,916	2,502	2,390
12,700	12,750	2,075	1,926	2,518	2,406
12,750	12,800	2,085	1,936	2,534	2,422
12,800	12,850	2,096	1,946	2,550	2,438
12,850	12,900	2,108	1,956	2,566	2,454
12,900	12,950	2,119	1,967	2,582	2,470
12,950	13,000	2,130	1,977	2,598	2,486
13,000	13,050	2,142	1,988	2,614	2,502
13,050	13,100	2,153	1,998	2,630	2,518
13,100	13,150	2,164	2,009	2,646	2,534
13,150	13,200	2,176	2,019	2,662	2,550
13,200	13,250	2,187	2,030	2,678	2,566
13,250	13,300	2,198	2,040	2,694	2,582
13,300	13,350	2,210	2,051	2,710	2,598
13,350	13,400	2,221	2,061	2,726	2,614
13,400	13,450	2,232	2,072	2,742	2,630
13,450	13,500	2,244	2,082	2,758	2,646
13,500	13,550	2,255	2,093	2,774	2,662
13,550	13,600	2,266	2,103	2,790	2,678
13,600	13,650	2,278	2,114	2,806	2,694
13,650	13,700	2,289	2,124	2,822	2,710
13,700	13,750	2,300	2,135	2,839	2,726
13,750	13,800	2,312	2,145	2,857	2,742
13,800	13,850	2,323	2,156	2,875	2,758
13,850	13,900	2,334	2,166	2,893	2,774
13,900	13,950	2,346	2,177	2,911	2,790
13,950	14,000	2,357	2,187	2,929	2,806
14,000	14,050	2,368	2,198	2,947	2,822
14,050	14,100	2,380	2,208	2,965	2,839
14,100	14,150	2,391	2,219	2,983	2,857
14,150	14,200	2,402	2,229	3,001	2,875
14,200	14,250	2,414	2,240	3,019	2,893
14,250	14,300	2,425	2,250	3,037	2,911
14,300	14,350	2,436	2,261	3,055	2,929
14,350	14,400	2,448	2,271	3,073	2,947
14,400	14,450	2,461	2,284	3,091	2,965
14,450	14,500	2,475	2,296	3,109	2,983
14,500	14,550	2,488	2,309	3,127	3,001
14,550	14,600	2,502	2,321	3,145	3,019
14,600	14,650	2,515	2,334	3,163	3,037
14,650	14,700	2,529	2,346	3,181	3,055
14,700	14,750	2,542	2,359	3,199	3,073
14,750	14,800	2,556	2,371	3,217	3,091
14,800	14,850	2,569	2,384	3,235	3,109
14,850	14,900	2,583	2,396	3,253	3,127
14,900	14,950	2,596	2,409	3,271	3,145
14,950	15,000	2,610	2,421	3,289	3,163

1975 Tax Computation Worksheet (Use only if your total income, line 12 of Form 1040A, is $15,000 or more)

1	Enter your total income from line 12 of Form 1040A	$ 17,000.00
2	If on Form 1040A, you checked the box on line: 2 or 5, enter 16% of line 1, above, but not more than $2,600	2,300.00
	1 or 4, enter $2,300	
	3, enter $1,300	
3	Subtract line 2 from line 1	14,700.00
4	Multiply total number of exemptions claimed on line 7, Form 1040A, by $750	750.00
5	Taxable income (subtract line 4 from line 3)	13,950.00
6	Tax on amount on line 5. Use appropriate tax rate schedule on page 19. Enter here and on line 13a of Form 1040A and check the block for Tax Computation Worksheet. (Do Not File—Retain for Your Records)	$ 3,195.50

1975 Tax Rate Schedules

If you do not use one of the Tax Tables, figure your tax on the amount on line 5 of the Tax Computation Worksheet on page 18, by using the appropriate Tax Rate Schedule on this page. Enter tax on line 6 of Tax Computation Worksheet and on Short Form 1040A, line 13a. **Note:** *It may be to your advantage to use the "averaging method" and file Form 1040 if after subtracting $3,000 from your 1975 taxable income (line 5 of the Tax Computation Worksheet), the balance is over 30 percent of the total of your taxable income for the last four years (1971 through 1974). See Schedule G (Form 1040) and* **Publication 506,** *Computing Your Tax Under the Income Averaging Method.*

SCHEDULE X—Single Taxpayers Not Qualifying for Rates in Schedule Y or Z

Use this schedule if you checked the box on Short Form 1040A, line 1.

If the amount on line 5 of the Tax Computation Worksheet is:		Enter on line 6 of Tax Computation Worksheet:	
Not over $500		14% of the amount on line 5 of the Tax Computation worksheet.	
Over—	But not over—		of the amount over—
$500	$1,000	$70+15%	$500
$1,000	$1,500	$145+16%	$1,000
$1,500	$2,000	$225+17%	$1,500
$2,000	$4,000	$310+19%	$2,000
$4,000	$6,000	$690+21%	$4,000
$6,000	$8,000	$1,110+24%	$6,000
$8,000	$10,000	$1,590+25%	$8,000
$10,000	$12,000	$2,090+27%	$10,000
$12,000	$14,000	$2,630+29%	$12,000
$14,000	$16,000	$3,210+31%	$14,000
$16,000	$18,000	$3,830+34%	$16,000
$18,000	$20,000	$4,510+36%	$18,000
$20,000	$22,000	$5,230+38%	$20,000
$22,000	$26,000	$5,990+40%	$22,000
$26,000	$32,000	$7,590+45%	$26,000
$32,000	$38,000	$10,290+50%	$32,000
$38,000	$44,000	$13,290+55%	$38,000
$44,000	$50,000	$16,590+60%	$44,000
$50,000	$60,000	$20,190+62%	$50,000
$60,000	$70,000	$26,390+64%	$60,000
$70,000	$80,000	$32,790+66%	$70,000
$80,000	$90,000	$39,390+68%	$80,000
$90,000	$100,000	$46,190+69%	$90,000
$100,000	.....	$53,090+70%	$100,000

SCHEDULE Y—Married Taxpayers and Qualifying Widows and Widowers

If you are a married person living apart from your spouse, see page 4, paragraph 1(d), of the instructions to see if you can be considered as "unmarried" for purposes of using Schedule X or Z.

Use this schedule if you checked the box on Short Form 1040A, line 2 or 5.

Married Taxpayers Filing Joint Returns and Qualifying Widows and Widowers (See page 4)

If the amount on line 5 of the Tax Computation Worksheet is:		Enter on line 6 of Tax Computation Worksheet:	
Not over $1,000		14% of the amount on line 5 of the Tax Computation worksheet.	
Over—	But not over—		of the amount over—
$1,000	$2,000	$140+15%	$1,000
$2,000	$3,000	$290+16%	$2,000
$3,000	$4,000	$450+17%	$3,000
$4,000	$8,000	$620+19%	$4,000
$8,000	$12,000	$1,380+22%	$8,000
$12,000	$16,000	$2,260+25%	$12,000
$16,000	$20,000	$3,260+28%	$16,000
$20,000	$24,000	$4,380+32%	$20,000
$24,000	$28,000	$5,660+36%	$24,000
$28,000	$32,000	$7,100+39%	$28,000
$32,000	$36,000	$8,660+42%	$32,000
$36,000	$40,000	$10,340+45%	$36,000
$40,000	$44,000	$12,140+48%	$40,000
$44,000	$52,000	$14,060+50%	$44,000
$52,000	$64,000	$18,060+53%	$52,000
$64,000	$76,000	$24,420+55%	$64,000
$76,000	$88,000	$31,020+58%	$76,000
$88,000	$100,000	$37,980+60%	$88,000
$100,000	$120,000	$45,180+62%	$100,000
$120,000	$140,000	$57,580+64%	$120,000
$140,000	$160,000	$70,380+66%	$140,000
$160,000	$180,000	$83,580+68%	$160,000
$180,000	$200,000	$97,180+69%	$180,000
$200,000	.....	$110,980+70%	$200,000

Use this schedule if you checked the box on Short Form 1040A, line 3.

Married Taxpayers Filing Separate Returns

If the amount on line 5 of the Tax Computation Worksheet is:		Enter on line 6 of Tax Computation Worksheet:	
Not over $500		14% of the amount on line 5 of the Tax Computation worksheet.	
Over—	But not over—		of the amount over—
$500	$1,000	$70+15%	$500
$1,000	$1,500	$145+16%	$1,000
$1,500	$2,000	$225+17%	$1,500
$2,000	$4,000	$310+19%	$2,000
$4,000	$6,000	$690+22%	$4,000
$6,000	$8,000	$1,130+25%	$6,000
$8,000	$10,000	$1,630+28%	$8,000
$10,000	$12,000	$2,190+32%	$10,000
$12,000	$14,000	$2,830+36%	$12,000
$14,000	$16,000	$3,550+39%	$14,000
$16,000	$18,000	$4,330+42%	$16,000
$18,000	$20,000	$5,170+45%	$18,000
$20,000	$22,000	$6,070+48%	$20,000
$22,000	$26,000	$7,030+50%	$22,000
$26,000	$32,000	$9,030+53%	$26,000
$32,000	$38,000	$12,210+55%	$32,000
$38,000	$44,000	$15,510+58%	$38,000
$44,000	$50,000	$18,990+60%	$44,000
$50,000	$60,000	$22,590+62%	$50,000
$60,000	$70,000	$28,790+64%	$60,000
$70,000	$80,000	$35,190+66%	$70,000
$80,000	$90,000	$41,790+68%	$80,000
$90,000	$100,000	$48,590+69%	$90,000
$100,000	.....	$55,490+70%	$100,000

SCHEDULE Z—Unmarried (or legally separated) Taxpayers Who Qualify as Heads of Household (See page 4)

Use this schedule if you checked the box on Short Form 1040A, line 4.

If the amount on line 5 of the Tax Computation Worksheet is:		Enter on line 6 of Tax Computation Worksheet:	
Not over $1,000		14% of the amount on line 5 of the Tax Computation worksheet.	
Over—	But not over—		of the amount over—
$1,000	$2,000	$140+16%	$1,000
$2,000	$4,000	$300+18%	$2,000
$4,000	$6,000	$660+19%	$4,000
$6,000	$8,000	$1,040+22%	$6,000
$8,000	$10,000	$1,480+23%	$8,000
$10,000	$12,000	$1,940+25%	$10,000
$12,000	$14,000	$2,440+27%	$12,000
$14,000	$16,000	$2,980+28%	$14,000
$16,000	$18,000	$3,540+31%	$16,000
$18,000	$20,000	$4,160+32%	$18,000
$20,000	$22,000	$4,800+35%	$20,000
$22,000	$24,000	$5,500+36%	$22,000
$24,000	$26,000	$6,220+38%	$24,000
$26,000	$28,000	$6,980+41%	$26,000
$28,000	$32,000	$7,800+42%	$28,000
$32,000	$36,000	$9,480+45%	$32,000
$36,000	$38,000	$11,280+48%	$36,000
$38,000	$40,000	$12,240+51%	$38,000
$40,000	$44,000	$13,260+52%	$40,000
$44,000	$50,000	$15,340+55%	$44,000
$50,000	$52,000	$18,640+56%	$50,000
$52,000	$64,000	$19,760+58%	$52,000
$64,000	$70,000	$26,720+59%	$64,000
$70,000	$76,000	$30,260+61%	$70,000
$76,000	$80,000	$33,920+62%	$76,000
$80,000	$88,000	$36,400+63%	$80,000
$88,000	$100,000	$41,440+64%	$88,000
$100,000	$120,000	$49,120+66%	$100,000
$120,000	$140,000	$62,320+67%	$120,000
$140,000	$160,000	$75,720+68%	$140,000
$160,000	$180,000	$89,320+69%	$160,000
$180,000	.....	$103,120+70%	$180,000

Take Stock in America

Buy U.S. Savings Bonds Where you work or bank

(162)

Short Form 1040A is the least complicated U. S. Individual Income Tax Return to complete. As a tax accountant, one of your responsibilities would be to help a client complete such a form. On the next page is a sample Form 1040A that has been completed using the following information

Chris P. Jones
999 Ninth Street, Apt. 8
Notown, New Jersey 11111 (Soade County, Manne Township)

Filing Status: Single
Age: 26
Occupation: Writer
Social Security Number: 123-45-6789
Wages $12,000
Interest: $475
Income tax withheld: $2,067.60
Tax taken from Tax Table 1 (page 161A): $2,022

No excess FICA withheld

Notice that the tax accountant must sign the return as the preparer.

Short Form 1040A U.S. Individual Income Tax Return

Department of the Treasury Internal Revenue Service **1975**

Please place label on form you file. Make all necessary changes on label

Name (If joint return, give first names and initials of both): Chris P. | Last name: Jones

Your social security number: 123 45 6789

For Privacy Act Notification, see page 2 of Instructions.

Present home address (Number and street, including apartment number, or rural route): 999 Ninth St., Apt. 8

Spouse's social security no.:

For IRS use only

City, town or post office, State and ZIP code: Notown, New Jersey 11111

Occupation: Yours ► writer; Spouse's ►

Requested by Census Bureau for Revenue Sharing

A In what city, town, village, etc., do you live? Notown, N.J.

B Do you live within the legal limits of the city, town, etc.? [X] Yes [ ] No [ ] Don't know

C In what county and State do you live? County: Soade; State: NJ

D In what township do you live? (See page 5.) Manne

Filing Status

1 [X] Single (check only ONE box)
2 [ ] Married filing joint return (even if only one had income)
3 [ ] Married filing separately. If spouse is also filing give spouse's social security number in designated space above and enter full name here ►
4 [ ] Unmarried Head of Household (See page 4 of Instructions) ►
5 [ ] Qualifying widow(er) with dependent child (Year spouse died ► 19). See page 4 of Instructions.

Exemptions

6a Regular [X] Yourself [ ] Spouse — Enter number of boxes checked ► 1
b First names of your dependent children who lived with you — Enter number ►
c Number of other dependents (from line 22) ►
d Total (add lines 6a, b, and c) ► 1
e Age 65 or over [ ] Yourself [ ] Spouse; Blind [ ] Yourself [ ] Spouse — Enter number of boxes checked ►
7 Total (add lines 6d and e) ► 1

8 Presidential Election Campaign Fund ► Do you wish to designate $1 of your taxes for this fund? Yes [ ] No [ ] If joint return, does your spouse wish to designate $1? Yes [ ] No [ ] Note: If you check the "Yes" box(es) it will not increase your tax or reduce your refund

Attach Copy B of Forms W-2 and Check or Money Order here.

9 Wages, salaries, tips, and other employee compensation (Attach Forms W-2. If unavailable, see page 6 of Instructions)	9	12,000	00
10a Dividends (if over $400, see Instructions at top of page 3) $ ____ 10b Less exclusion $ ____ Balance ►	10c	475	00
11 Interest income (if over $400, see Instructions at top of page 3)	11		
12 Total (add lines 9, 10c, and 11) **(Adjusted Gross Income)** (If less than $8,000, see page 18 of Instructions on "Earned Income Credit")	12	12,475	00

- **If you want IRS to figure your tax, see page 6 of Instructions.**
- **If line 12 is under $15,000, find tax in Tax Tables (on pages 8–18) and enter on line 13a, on the back.**
- **If line 12 is $15,000 or more, figure your tax using the Tax Computation Worksheet on page 18 of Instructions.**

13a Tax, check if from: [x] Tax Tables (pages 8–18) **OR** [ ] Tax Computation Worksheet (page 18)			13a	2,022 00
b Credit for personal exemptions (multiply line 6d by $30)			b	30 00
14a Balance (subtract line 13b from line 13a). If less than zero, enter zero			14a	1,992 00
b Credit for contributions to candidates for public office (see page 7 of Instructions)			b	--
15 Income tax (subtract line 14b from line 14a). If less than zero, enter zero			15	1,992 00
16a Total Federal income tax withheld (attach Forms W-2 to front)	16a	2,067 60		
b Excess FICA, RRTA, or FICA/RRTA tax withheld (two or more employers—see page 7 of Instructions)	b	--		
c 1975 estimated tax payments (include amount allowed as credit from 1974 return)	c	--		
d Earned income credit	d	--		
17 Total (add lines 16a, b, c, and d)			17	2,067 60
18 If line 15 is larger than line 17, enter **BALANCE DUE IRS** ►			18	
19 If line 17 is larger than line 15, enter amount **OVERPAID** ►			19	75 60
20 Amount of line 19 to be **REFUNDED TO YOU** ►			20	75 60
21 Amount of line 19 to be credited on 1976 estimated tax ► 21				

Pay amount on line 18 in full with this return. Write social security number on check or money order and make payable to Internal Revenue Service.

If all of overpayment (line 19) is to be refunded (line 20), make no entry on line 21.

Other Dependents

(a) NAME	(b) Relationship	(c) Months lived in your home. If born or died during year, write B or D.	(d) Did dependent have income of $750 or more?	(e) Amount YOU furnished for dependent's support. If 100% write ALL.	(f) Amount furnished by OTHERS including dependent.
				$	$

22 Total number of dependents listed in column (a). Enter here and on line 6c ►

Under penalties of perjury, I declare that I have examined this return, including accompanying schedules and statements, and to the best of my knowledge and belief it is true, correct and complete. Declaration of preparer (other than taxpayer) is based on all information of which preparer has any knowledge.

Sign here

Your signature — Date

(Your name here)

Spouse's signature (if filing jointly, BOTH must sign even if only one had income)

Preparer's signature (other than taxpayer) — Date

Address (and ZIP Code)

190

PUBLIC SERVICE

CLUSTER

Bank Teller
Meter Reader
Tax Assessor

Public Service Cluster

BANK TELLER

The services offered by the banking industries are used by all of us at one time or another. Whether the purpose is savings, checking, commercial business or loans, the full services of banks are important in our daily lives.

As banking customers, most of us have contact with the bank tellers. They are the individuals who handle our deposit and withdrawal transactions. The tellers record the transactions for the customers. The teller may be balancing a person's savings or checking account, accepting loan repayments, cashing employment checks or traveler's checks. All of these duties demand that the teller be accurate and responsible with strong ability in business mathematics. Working with the public's financial business requires the teller to be trustworthy and knowledgeable. Mistakes can be costly, so attention to detail is necessary for a career as a bank teller. On any given business day, a teller could handle large sums of money. At the end of the work day, each bank teller counts the money and makes sure that the day's transactions are balanced.

To prepare for a career as a bank teller, a high school diploma is necessary. Students should study business courses, like bookkeeping and business mathematics. This is adequate preparation for employment by banks. Other banking positions, like officers and branch managers require advanced college degrees in business and accounting. Familiarity with computer technology is helpful for some banking positions.

Combine these qualifications with the pleasant working atmosphere of the banking industry and a career as a bank teller is quite an attractive one.

Activity

A bank teller spends a lot of time handling small or large sums of money. At the end of the day, transactions that have taken place must be tallied on a Cash Proof Sheet. This daily sheet is actually a balance page for balancing these monetary sums.

On the next page is a copy of the Cash Proof Sheet for J. Smith on April 30, 1978. J. Smith has already completed the form but notices it will not balance. Since the "starting cash" at the beginning of the day was $20,000 and $5,418.55 was taken in at the teller's window with $8,598.98 paid out in cashing checks, the net result is $16,819.57. This figure is verified by the machine that J. Smith has used all day. Problems appear after J. Smith has actually counted the money left at the end of the day. Packaged currency

(bills) and packaged silver (coins) is listed. Till currency and silver refers to money that cannot be packaged or "strapped", i.e. loose bills and coins. Since J. Smith's error amounts to $2,982.75 over the required amount, the head teller is called. As the head teller, you must try to find the errors. After counting the money, you realize there are 19 quarters ($4.75) instead of 18 quarters ($4.50).

Then you notice several addition mistakes. Recopy J. Smith's Cash Proof Sheet, fixing all mistakes. See if you can "balance" the teller's finances. Use a calculator if you have one.

CASH PROOF SHEET

Date 4-30-78

Tellers Signature J. Smith Tellers No. 5

		Packaged Currency	Till Currency
	Mutilated		
	$1000		
	500		
1000's	100	5 000 00	450 00
1000's	50	2 000 00	200 00
1000's	20	3 000 00	420 00
500's	10	3 000 00	220 00
250's	5	2 000 00	50 00
50's	2	100 00	12 00
50's	1	200 00	47 00
	TOTAL	18 300 00	1 379 00
	COIN	Packaged Silver	Till Silver
	Mutilated		
20's	$1.00		5 00
10's	.50	10 00	3 50
10's	.25	20 00	4 50
5's	.10	10 00	4 50
2's	.05	10 00	2 35
1's	.01	50 00	0 47
	TOTALS	100 00	23 32

Proof				
Starting Cash	20,000.00	Package Currency	18 300 00
Cash In	5,418.55	Till Currency	1 379 00
		Package Silver	100 00
		Till Silver	23 32
Cash Out	8,598.98		
Total Cash	16,819.57	Total Cash	19 802 32
		Short - plus	
		Over - less	2 982 75
		Total Cash	16 819 57

ANSWERS:

CASH PROOF SHEET

	Packaged Currency	Till Currency
Mutilated	---	---
$1000	---	---
500	---	---
100	5,000.00	450.00
50	2,000.00	200.00
20	3,000.00	420.00
10	3,000.00	220.00
5	2,000.00	50.00
2	100.00	12.00
1	200.00	47.00
TOTAL	15,300.00	1,399.00

COIN	Packaged Silver	Till Silver
Mutilated	---	---
$1.00	---	5.00
.50	10.00	3.50
.25	20.00	4.75
.10	10.00	4.50
.05	10.00	2.35
.01	50.00	0.47
TOTAL	100.00	20.57

Proof	
Starting Cash	20,000.00
Cash In	5,418.55
Cash Out	8,598.98
Total Cash	16,819.57

Packaged Currency	15,300.00
Till Currency	1,399.00
Package Silver	100.00
Till Silver	20.57
Total Cash	16,819.57
Short - plus	0
Over - less	0
Total Cash	16,819.57

SKILL AREAS:

Decimals: addition, subtraction, multiplication, division

Public Service Cluster

METER READER

In order to assess homeowners for their use and consumption of gas, electric and water, their home meters or gauges must be read and the figures accurately recorded on a regular basis. The persons who provide this important public service are the meter readers. The readings are recorded and the homeowner is then sent a bill reflecting the amount owed by the consumer. It is important that this service be performed carefully as the payments are based on reliable information registered by the meter reader.

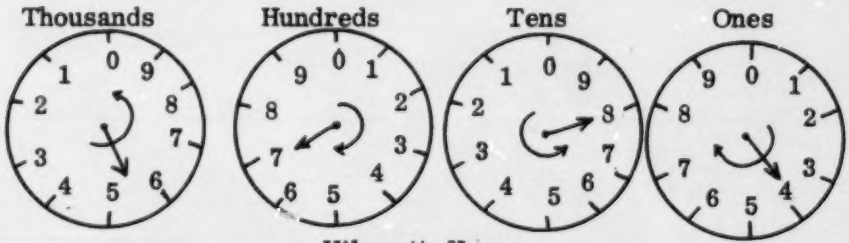
The electric meter measures the amount of electricity used in kilowatt hours. Gas and water consumption are measured in units of cubic feet. You can see, therefore, that the cost depends on which public service is being measured. Persons interested in this career area would need gauge reading experience, basic mathematics and measuring skills.

In the following activity you will simulate the work of a meter reader. The activity will also ask you to solve some problems involving the consumer's costs for these public services.

Activity

Electric Meter Reader — Every home depends on the power source of electricity. An electric meter measures this consumption of electricity in kilowatt-hours (KWH).

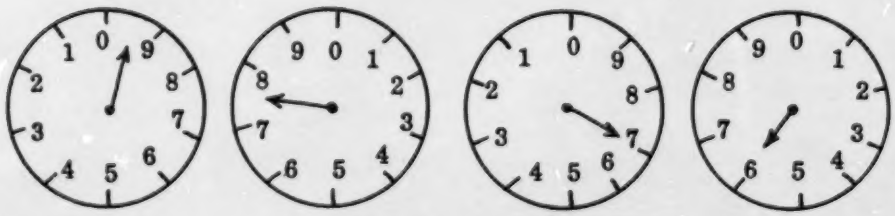
Example:



The kilowatt hours are recorded on the dials. You read the dials from left to right. If the pointer is between two numbers, use the previous number.

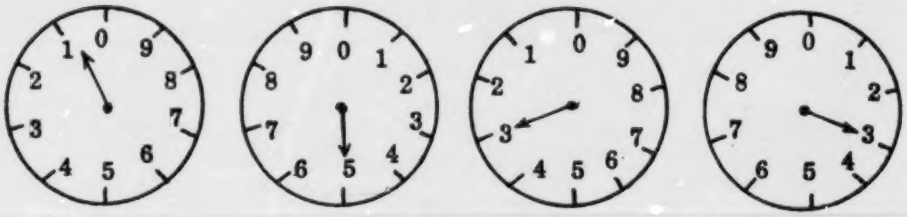
This example reads 5784 KWH

1. Complete the following electric meter reading:

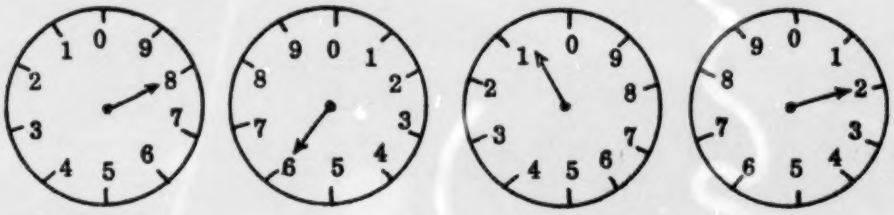


1. Meter reading is 195.

2. Meter reading is _____.

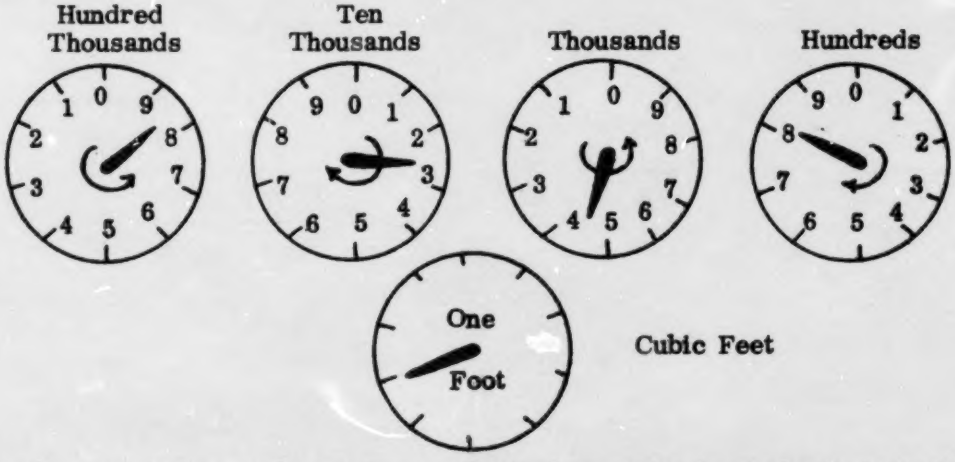


3. Meter reading is_____.



Gas Meter Reader — Not all homeowners have gas service. However, natural gas is a popular source of energy for the home. Gas consumption varies greatly as to whether the household cooks and/or heats with gas. Gas is measured in units of 100 cubic feet. This is symbolized by CCF.

Example:

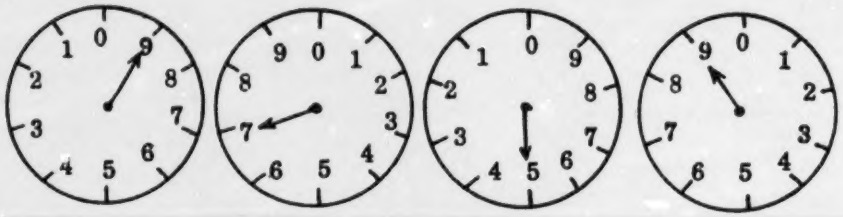


The four top dials are the readings. The bottom meter is used only to test accuracy of the meters. Each point on this dial is 1CCF or 100 cubic feet. One complete revolution on the dial located on the far right records 10CCF which is 1000 cubic feet.

This example reading is 8248 CCF, which is 8248 x 100 cu. feet or 824,800 cubic feet.

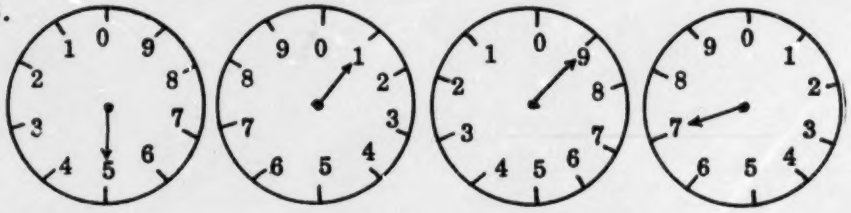
Complete the following gas meter readings:

4.



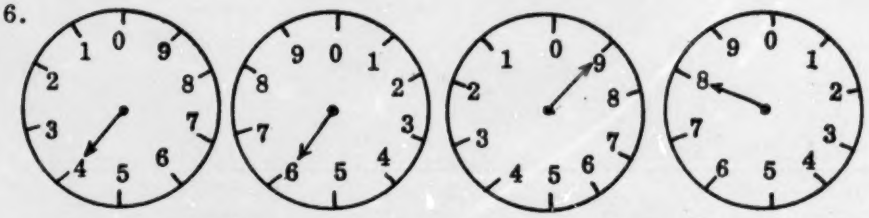
4. Meter reading_____

5.



5. Meter reading_____

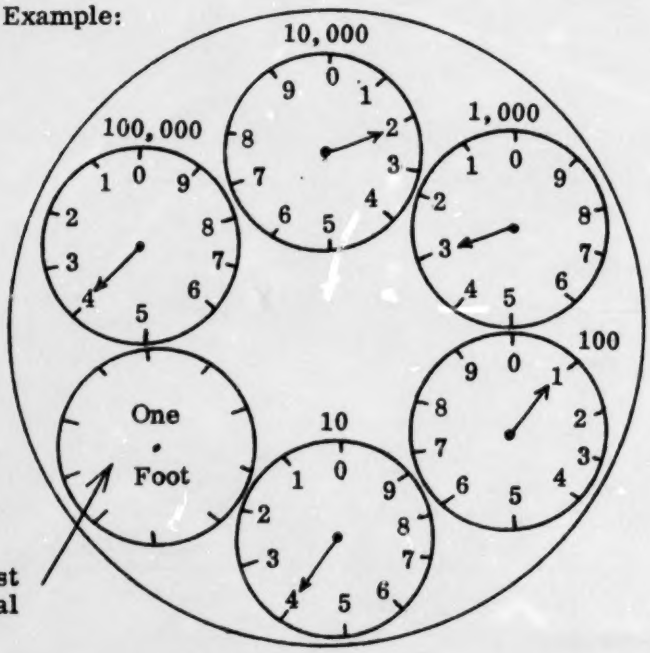
6.



6. Meter reading_____

Water Meter Reader — Every household depends on the water service provided by the community. The amount of water consumed is based on cubic feet. The meter reader always records the lower number when the pointer is between two numbers.

Example:



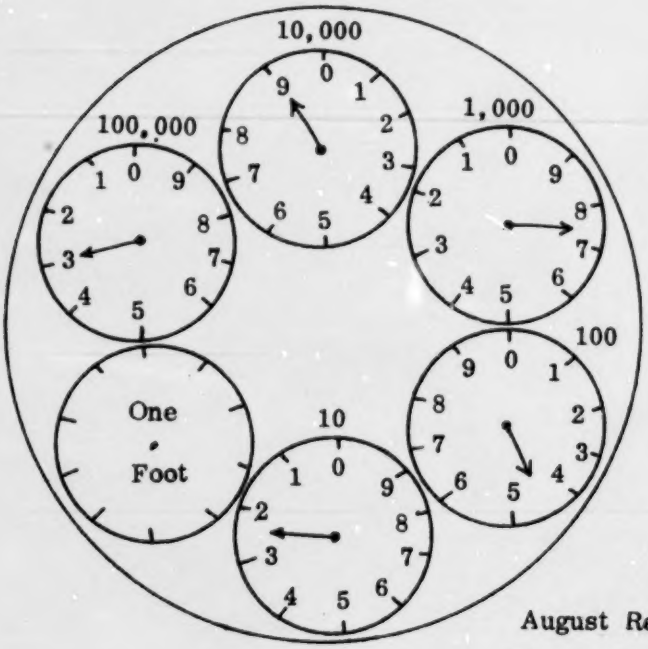
The reading on this water meter is 423,140 cu. ft.

Note: Water company meters do vary in appearance.

Complete the following water meter readings over a nine month period. Water meter readers check the meter every three months.

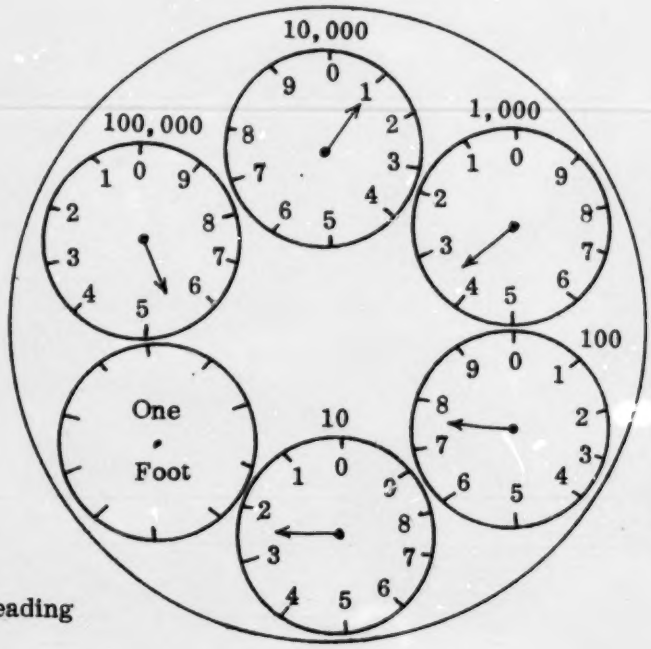
January Reading

7. _____



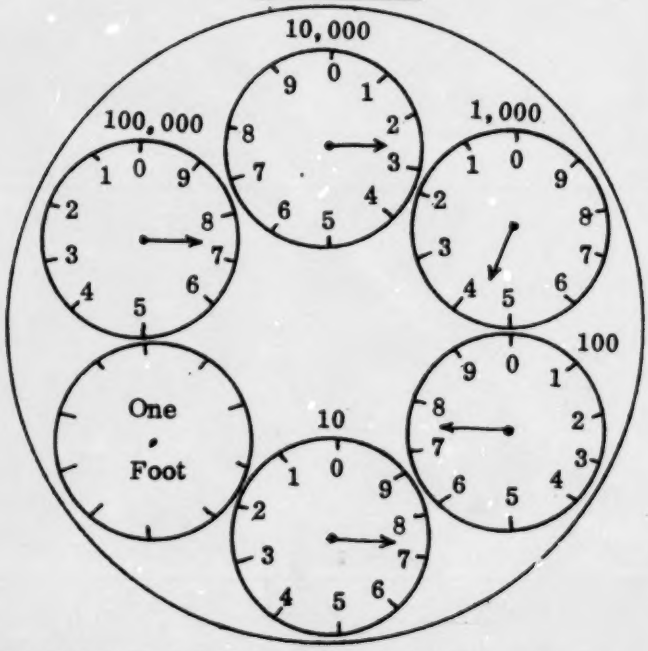
April Reading

8. _____



August Reading

9. _____



10. Reading your home meters. Locate your water and electric (gas, if possible) meters in your home. Read the meter as you did in the previous examples. Record the readings. After three days, read and record the figures. What is your household's consumption of gas, electric and water?

ANSWERS:

1. 9,776
2. 533
3. 8,602
4. 975,900
5. 519,700
6. 469,800
7. 397,420
8. 513,720
9. 724,770
10. Answers will vary

SKILL AREAS:

Place value

Gauge reading

Public Service Cluster

TAX ASSESSOR

Every person who owns property is subject to a real estate tax which is based upon the size and location of the land as well as the kind of building that might be constructed there. The individual who computes this tax is a local government official called a tax assessor. She/he may either be elected directly by the citizens of the town or appointed by other elected officials (mayor and/or town council, etc.)

When a tax assessor computes the value of property and buildings, she/he investigates for certain important facts. If it is a private home, some of these are:

1. The size of the land.
2. Where the land is located.
3. The length and width of the building foundation which is constructed on the property.
4. The number of bathrooms, fireplaces and material used to cover the driveway.

Much of a tax assessor's day is spent outside the office since data must be gathered by first-hand inspection of property and buildings. After visiting a specific site and recording necessary information, he/she can then return to the office to compute the assessed value of the building and/or land. To complete this work, there are numerous tables and formulas which must be consulted. Of course, electronic calculators are helpful and do save time, but it is the skill and understanding of the assessor which is of major importance.

Not only must this person be skilled in math, but the tax assessor should also be effective in dealing with the public when visiting homes and property and also explaining assessment computations.

Activity

The product of the following two numbers determine an owner's final property tax:

1. The assessed value of a building and/or property.
   This amount is what is calculated by the tax assessor.
2. The tax rate which is a dollar value per each hundred dollars of assessed value. This rate is based upon revenue needed by various county and local government agencies so that they can function to serve the public.

EXAMPLE OF A TAX CALCULATION:

1. Assessed value of a building and property: $50,000.00.

2. Tax rate: $4.00 per hundred dollars of assessed value.

$$\text{Tax} = \frac{\text{Assessed Value}}{100} \times \text{Tax Rate}$$

$$\text{Tax} = \frac{\$50,000.00}{100} \times \$4.00$$

$$\text{Tax} = \$5.00 \times \$4.00$$

$$\text{Tax} = \$2,000.00$$

Now, by using this formula and the information found below, determine (1) the assessed value of the home and property and (2) the actual tax which the owner would be required to pay.

Table of Typical Dollars Values for a One-Family, One-Story Home

$1.30 per sq. foot of basement

$11.10 per sq. foot of first floor

$486.00 for each bathroom in excess of one

$3.65 per sq. foot of garage space

$.56 per sq. foot of black-top driveway

$.60 per sq. foot of first floor for central air conditioning

$400.00 for each fireplace

$.97 for each foot of frontage (width of property)

$10,750.00 for standard lot

and

$3.14 tax rate per hundred dollars of assessed value.

House Description - As Determined by the Tax Assessor

Type of House - One-Family, One-Story on a standard lot

1. 60' Frontage
2. 40' x 30' Basement Dimensions
3. 40' x 30' First Floor Dimensions
4. 2½ Bathrooms
5. 11' x 24' Garage
6. 12' x 20' Black-top Driveway
7. Central Air Conditioning
8. 1 Fireplace
9. Standard Lot
10. Assessed Value?
11. Tax?

ANSWERS:

		ASSESSMENT
1.	60' Frontage	$58.20
2.	40' x 30' Basement	$1,560.00
3.	40' x 30' First Floor	$13,320.00
4.	2½ Baths	$729.00
5.	11' x 24' Garage	$933.60
6.	12' x 20' Black-top Driveway	$134.40
7.	Central Air (based on sq. footage of first floor)	$720.00
8.	1 Fireplace	$400.00
9.	Standard Lot	$10,750.00
10.	Assessed Value	$28,635.20

11. Tax = $\frac{28,635.20}{100} \times 3.14$

286.35 x 3.14 = $899.14 (Tax)

SKILL AREAS:

Powers of 10: division

Decimals: addition, multiplication

Area: rectangle

TRANSPORTATION

CLUSTER

Flight Engineer
Mechanic
Toll Collector

Transportation Cluster

FLIGHT ENGINEER

The increasing need for faster traveling requires skilled personnel in the airline industry. An important member of the flight crew is the flight engineer. This qualified person must gain a background in mathematics as well as in mechanical and scientific engineering. Determining accurate arrival and departure times and fuel consumption are operations a flight engineer must perform.

A thorough understanding of all flight and crew operations is necessary, as the flight engineer serves as a backup pilot in emergency situations. Therefore, logical thinking and quick accurate decision-making are important abilities for this career.

The following activity will ask you to perform some of the tasks of a flight engineer. You will be computing mileage estimates for actual continental flight patterns and estimating flight times through the continental time zones.

Activity

The flight engineer examines the flight plan and determines the time of departure and arrival, the route and weather conditions.

Using the map and scale below, perform the work of a flight engineer and determine the distance for the following flights: (Round off your measurements to the nearest half-inch)

Scale: 1" to 750 miles

1. From New York to Miami?
2. From Miami to San Francisco?
3. From San Francisco to New York?
4. From Dallas to San Francisco?
5. From Chicago to New York?

Actual flying time varies according to a variety of factors: weather conditions, airport traffic, etc. The flight engineer knows that a 747 jet travels at a speed of 625 miles per hour. Determine the flying time of a 747 for the distances of the previous flights:

6. _____ hours

7. _____ hours

8. _____ hours

9. _____ hours

10. _____ hours

Using the given United States map and considering the four time zones (Pacific, Mountain, Central, Eastern), determine the departure or arrival of the following flights:

	DEPARTURE	ARRIVAL
11.	New York - 8:00 a.m.	Miami _____
12.	Miami - 12:00 noon	San Francisco _____
13.	San Francisco _____	New York - 5:23 p.m.
14.	Dallas _____	San Francisco - 1:30 p.m.
15.	Chicago - 11.45 a.m.	New York _____

ANSWERS:

1. 1125 miles
2. 2625 miles
3. 2625 miles
4. 1500 miles
5. 750 miles
6. 1.8 hrs. = 1 hr. 48 min.
7. 4.2 hrs. = 4 hr. 12 min.
8. 4.2 hrs. = 4 hr. 12 min.
9. 2.4 hrs. = 2 hr. 24 min.
10. 1.2 hrs. = 1 hr. 12 min.
11. 9:48 a.m.
12. 1:12 p.m.
13. 10:11 a.m.
14. 1:06 p.m.
15. 1:57 p.m.

SKILL AREAS:

Formula Application

Decimals: multiplication (1-place decimal)

Whole Numbers: division (3-digits)

Transportation Cluster

MECHANIC

Many specialized and technical skill areas are incorporated in a career in mechanics. However, any individual seeking a future in this field must realize the constant demand for accuracy and precision. Servicing, repairing, overhauling and inspecting engines require the valuable talents of a knowledgeable mechanic. Many industries, with a variety of plant locations, depend on reliable freight transportation. The skills of a Diesel mechanic are vital to insure safe and efficient engine operation. Preventive maintenance can save lives as well as money. Again, many mechanics specialize in one particular area of engine maintenance.

Service station and automobile sales agency mechanics have educational backgrounds in mathematics and science and also technical training in equipment operation. With a population demanding speed and mechanical efficiency, the services of a qualified mechanic are valued by both industry and citizens alike.

Some basic engine specifications are used by automotive mechanics. In the following activity, you will use a few basic formulas to solve some mechanical problems.

Activity

Here are some basic formulas with which a mechanic is familiar. Complete the suggested research project:

The transmission ratio is the ratio of engine to drive shaft speed. Therefore:

$$\text{Transmission ratio} = \frac{\text{engine speed}}{\text{drive shaft speed}}$$

The rear axle ratio explains how the speed of the drive shaft is changed to the speed of the rear axle. Therefore:

$$\text{Rear Axle ratio} = \frac{\text{drive shaft speed}}{\text{rear axle speed}}$$

Research Project:

Your local automobile agency and perhaps a local service station have advertising pamphlets. Ask for these pamphlets making sure the specifications for bore and stroke and transmission and rear axle ratio are somewhere in the pamphlet.

Use the bore and stroke specifications and work out the engine displacement. If the engine ratio information is available also work out the transmission and rear axle ratios.

Interview the mechanics where you obtain these specifications and ask them why these figures are important in their work. Write a summary of this interview.

The following activity will give you additional information about the technical knowledge with which a mechanic must operate. Read the following information concerning engine displacement, compression ratios, transmission ratio and pulley speed.

Engine displacement - Engine displacement of one cylinder is the amount of space through which the piston travels in one stroke. The displacement of a cylinder is a cylinder of space.

The formula for volume of a cylinder is: $V = \pi r^2 h$

The formula for the displacement of a cylinder is:

$$D = \pi \times \left(\frac{\text{bore}}{2}\right)^2 \times \text{stroke}$$

Use $\pi = 3.14$

D = Displacement

h = Stroke of the engine

$r = \left(\frac{\text{bore}}{2}\right)$

Total displacement of an engine is the sum of the displacement of all the cylinders.

NOTE: Automobile engines have 4, 6 or 8 cylinders.

ANSWERS:

As this project is one of research for specification, the answers will vary depending upon the source of the students' information. The teacher can check the engine information with the formulas given.

SKILL AREAS:

Decimals: multiplication, division

Ratio

Formula Application

Transportation Cluster

TOLL COLLECTOR

Anyone traveling to any destination in the United States comes into contact with the bridge, parkway, tunnel or turnpike toll collector. With our vast newwork of roadways, the work of these individuals is a very valuable public service. The construction of new parkways and the repair of maintenance of roads is often financed through toll collections. The toll collectors are the recipient of the state regulated fees for the traveling vehicles. There are various vehicle classifications. The assessed toll depends on this classification. It is the toll collector who is familiar with this classification and requests the specified amount from the driver.

A general mathematics background is necessary as toll collectors total their intake of money upon completing their work day. This task requires careful computation and accuracy for the collector is responsible for these tolls. This mathematics background is also important because they are required to take a basic mathematics test as well as the job civil service examination for employment.

Often a toll collector is asked to supply directions for a motorist. This requires familiarity with the geographic region as well as accurate thinking and logic to estimate distances.

In the following activity you will solve some of the problems with which the toll collector might be concerned.

Activity

1. A toll collector on the Garden State Parkway must punch a specific button for each vehicle that passes through his/her toll booth. Vehicles are assigned to 1 of 7 classes depending upon the type of vehicle it is (car, truck, bus). At the end of the shift, the toll collector is responsible for counting the exact amount of money he/she has collected. This amount must match the total number of punches the machine has recorded as each vehicle passed. At the end of an ordinary day, approximately 1800 cars and 50 buses drive through each toll booth at the Union Plaza. Passenger cars are charged 25¢ at each plaza while buses pay 75¢. What is the normal intake for this collector?

2. Suppose the starting salary for a toll collector is $3.15 per hour. What would the annual (yearly) income be if the collector works a 40-hour week?

3. Side ramps of the Garden State Parkway usually charge a lower toll because the driver has only used the road a proportional distance. Here the typical toll for a passenger car is 15¢. If the toll collector amasses an amount to $226.35, how many punches should the machine have accumulated for this type of vehicle?

4. If there is only 1 toll collector at a side ramp and this person goes on a break for 20 minutes, the Garden State Parkway has enacted an "honor system" for the motorist who does not have the exact change for the toll. This system gives the driver the opportunity to take an empty envelop (provided at the toll booth) and mail it with the correct change to the Garden State Parkway Authority. There are exactly 6 ways in which the driver <u>can</u> have the exact change of 15¢. What are these 6 options?

5. For one entire year the traffic going across the George Washington Bridge in <u>both</u> directions totaled 76,544,400.

   a) Find the approximate number of vehicles crossing the bridge in the eastbound direction. Why isn't this number the exact total?

   b) Compute the daily average of vehicles crossing the bridge for the year in <u>one</u> direction.

   c) There are 3 work shifts (8 hours each) operating each day. If there are 8 toll collectors for each shift, how many vehicles can each toll collector anticipate?

   d) Although the tolls for the George Washington Bridge vary according to the number of axles the vehicle has, the smallest toll is $1.50 for passenger cars. This toll is collected only <u>once</u> in the eastbound lane. What is the minimal amount of money the toll collectors of the Port Authority of New York-New Jersey would have collected?

ANSWERS:

1. $487.50

2. $6,552.00

3. 1509 punches

4. a) 15 pennies
   b) 1 dime and 1 nickel
   c) 3 nickels
   d) 1 dime and 5 pennies
   e) 10 pennies and 1 nickel
   f) 2 nickels and 5 pennies

5. a) 38,272,200 (some people do not return)
   b) 104,855.34
   c) 4368.9723
   d) $57,408,300.00

SKILL AREAS:

Whole Numbers: division (up to 3 digits)

Decimals: addition, subtraction, multiplication

Money Conversion

ANSWERS:

1. $487.50

2. $6,552.00

3. 1509 punches

4. a) 15 pennies
   b) 1 dime and 1 nickel
   c) 3 nickels
   d) 1 dime and 5 pennies
   e) 10 pennies and 1 nickel
   f) 2 nickels and 5 pennies

5. a) 38,272,200 (some people do not return)
   b) 104,855.34
   c) 4368.9723
   d) $57,408,300.00

SKILL AREAS:

Whole Numbers: division (up to 3 digits)

Decimals: addition, subtraction, multiplication

Money Conversion